University of Calgary

PRISM Repository **https://prism.ucalgary.ca**

The Vault Open Theses and Dissertations

2013-07-15

Dismantling Barriers via Multiple Representation on Grade Nine Provincial Achievement Tests in Mathematics and Social Studies

Hickey, Evelyn Jane

Hickey, E. J. (2013). Dismantling Barriers via Multiple Representation on Grade Nine Provincial Achievement Tests in Mathematics and Social Studies (Doctoral thesis, University of Calgary, Calgary, Canada). Retrieved from https://prism.ucalgary.ca. doi:10.11575/PRISM/25721
http://hdl.handle.net/11023/810
Downloaded from PRISM Repository, University of Calgary

THE UNIVERSITY OF CALGARY

Dismantling Barriers via Multiple Representation on Grade Nine Provincial Achievement Tests in Mathematics and Social Studies

by

Evelyn Jane Hickey

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF EDUCATION

GRADUATE PROGRAMS IN EDUCATION

CALGARY, ALBERTA

JULY, 2013

© Evelyn Jane Hickey

ABSTRACT

Universal design for learning (UDL) provides a perspective that departs from a one-size-fits-all approach in the standard lecture and test style of educational practice. Incorporating the principles of UDL into assessment practice provides an opportunity to maximize student potentiality and also to increase student satisfaction with the process of writing provincial achievement tests. UDL, constructivism and multiple intelligences provide theoretical lenses through which learning and assessment are considered in this study.

The purpose of this mixed method study was to explore how the UDL principle of multiple representation may dismantle barriers on grade nine provincial achievement tests in mathematics and social studies. The design involved the provision of at least two formats of the exam to *all* students while they completed the provincial achievement test rather than as an accommodation for students with diagnosed learning needs. All students were given access to the audio format of the exam as well as the written format of the exam. Both qualitative and quantitative data were collected during the study. Student participants were invited to complete a pre and post survey to report on their testing experience. A sample of students was invited to participate in one-on-one interviews to provide further details about their experience. The educators who were involved with the study were invited to participate in the interviews. Several findings emerged from the descriptive and narrative analysis of data. Students and teachers indicated that multiple representation on the provincial achievement tests was helpful because it provided support for students who benefit from using audio along with written formats of the test. Multiple representation through the provision of audio may be beneficial

because students do no all have the same reading level and therefore may be compromised by the traditional printed format of the test.

The study's findings contribute to a much-needed dialogue for change about how multiple representation on large-scale assessment moves toward a more accessible and therefore more satisfactory testing environment for all learners. Multiple representation provide choices based on learning need or preference, which acknowledges and honours learner differences.

ACKNOWLEDGEMENTS

At the core of this work is a passion to make a difference in the lives of students as I continue building my insights about how technology can create opportunities for enhancing student capacity. Although this is one small piece of much more complexity in assessment and learning especially with educational policy, this endeavour is meant to create dialogue and reflection about barriers to learning, obvious and obfuscated. I feel privileged to have had this opportunity to meet and work with innovative, passionate people through my courses, through meetings and in the field. With sincere appreciation and gratitude for providing much needed support to bring this dissertation to completion, I would like to acknowledge those who made this journey possible.

I am thankful to my supervisory committee. Dr. Michele Jacobsen, my advisor, provided constructive feedback, important insight and continued enthusiastic support throughout the process of the initial ideas to the completion and documentation of this research. She affirmed my passion. I am grateful to her for helping me tease out my preliminary thoughts into a feasible plan, constructive feedback on my writing and for being a perpetual sounding board throughout. She helped to sustain me through this challenging process. Dr. Sharon Friesen contributed expert guidance along with demanding and detailed questions, which helped me to further develop my thinking. Dr. Diane Gereluk provided much needed critiques of my writing and built my perspective as a writer. The critiques and encouragement I received from my supervisory committee made a great difference.

I would like to thank my doctoral cohort for support and encouragement during this journey, especially in the beginning phases when I was finding my rhythm. These special people have become critical friends and I truly appreciate them.

I would like to thank Dr. John Reimer who supported me in getting this study approved by Alberta Education. I would also like to acknowledge the school district supervisors who gave permission for me to work within their region. I would like to thank the educators and students who participated in the study and for welcoming me into their schools. They could have declined but took the time to share their experiences with me. I truly appreciate their effort as they contributed data for my study. I want to acknowledge the office staff at each of the schools for collecting various forms associated with the research, which expedited the beginning steps.

I would like to thank Dr. Susan Crichton for providing mentorship even before I began this journey and filled me with enthusiasm for this quest. I also want to thank Dr. Matt Christison who demonstrated interest in my work and provided mentorship through supportive conversations and emails that helped me to consider how to balance my work. I would like to thank Dr. Jennifer Lock for her enthusiasm, encouragement and advice.

I would like to thank many of my students over the years, all of whom inspired me to create knowledge about their lived experience. Their challenges kept me thinking and seeking out research to support best practice.

I would like to thank teaching colleagues who took an interest in what I was pursuing, asking questions which helped me bring clarity to my thoughts and then to my writing.

Finally I would like to thank the very special people in my life: my family and friends. I would like to thank my friends for standing by me even when I did not always have the time to adequately nurture our friendship since starting this work and especially in the past year. I would like to thank my sister Monica for asking questions about specific ideas in my writing, which helped me create clarity. My family stood by patiently as I went through the many mountainous learning curves in pursuit of accomplishing this goal. I would like to thank my son Daniel who gave me insight about being authentic as an educator. I would like to thank my husband Jim because this journey would have been much more difficult without his consummate patience, encouragement and love. More than anyone, he knew that this was my "Mount Everest" and on many, many occasions he left me in solitude, picking up pieces for me, knowing as Robert Frost so eloquently wrote, "the woods are lovely, dark, and deep, but I have promises to keep, and miles to go before I sleep."

DEDICATION

For Madonna (Donnie)—her memory lives forever with me.

TABLE OF CONTENTS

ABSTRACT……. ii
ACKNOWLEDGEMENTS…….. iv
DEDICATION……. vi
TABLE OF CONTENTS…… vii
LIST OF TABLES…… x
LIST OF FIGURES……..xi

Chapter One INTRODUCTION
Joshua's Story……. 1
Rationale……. 4
Purpose of the Study…….. 6
Significance of the Study……... 8
Research Questions…… 9

Chapter Two RELEVANT LITERATURE
Relevant Literature…….11
Technology affordances……..... 13
Diversity…… 16
The Shoulders that Support UDL…….. 20
UDL is not a Euphemism for Assistive Technology……. 25
Misconceptions of UDL…… 27
UDL and Large-Scale Assessment…… 30
Large-Scale Assessment in Alberta……... 34
Promising Practices……36
Motivation for the Research…….. 38
Research Approach…… 40

Chapter Three RESEARCH DESIGN
Research Design……44
Researcher Profile……..48
Establishing a Site……..49

Preliminary Work……...50

Feasible Site……...51
Research Participants……52
Methodology……..53
Introduction of Research……53
Practice Tests……54
Study Instruments……..54
Provincial Achievement Test Options for Pilot……57
Ethics Approval……58
Data Collection, Organization……...59
Data Analysis……59

Chapter Four ANALYSIS AND INTERPRETATION OF RESULTS
Analysis Process……62
Survey Results……...63
Participation Numbers……...63
Use of Technology at Home……..64
Use of Technology at School……65
Interest in Access to Technology in Testing……68
Perspectives about Reading Ability……...71
Satisfaction with Access to Multiple Representation……74
Utilizing Audio Version with Printed Format……...78
Interview Results……...79
Transcription……..80
Responses about School Experiences and Use of Technology……..81
Responses about Access to Multiple Representation……83
Responses about Technology Use……..86
Advice from Students……....88
Teacher Interview Responses ……90
Emerging Themes……..92
UDL Supports Diversity……93
Facilitating UDL in Assessments……..94
Technology Restraints……...96
Construct Irrelevance……98

Chapter Five DISCUSSION, CONCLUSION AND RECOMMENDATIONS.....101
Trustworthiness of Data……102
Professional Implications……..104
Research Question……105
Students' Views……106
Teacher Insights……107
Challenges……110
Celebrations……...112
Alternative Explanations……...113
Generalizability of Findings……..114
Limitations and Delimitations……...115
Recommendations for Practice……..…....116
Recommendations for Future Research……..…...117

RERERENCES…….....122

APPENDICES……...137
A— Pre and Post Surveys……..…...137
B— Letter of Introduction about Research…….…….....142
C—Consent Forms……143
D—Student and Teacher Interview Questions…….....153

LIST OF TABLES

Table 1. Survey Participants by Gender……63
Table 2. Interview Participants by Gender……79

LIST OF FIGURES

Figure 1. Pre-Survey: How much time do you use computers at home?.....64

Figure 2. Post-Survey: How much time do you use computers at home?.....65

Figure 3. Pre Survey: How much time do you use computers at school?.....66

Figure 4. Post Survey: How much time do you use computers at school?.....66

Figure 5. Pre-Survey: How frequently did you use technology in testing?.....67

Figure 6. Post-Survey: How frequently did you use technology in testing?.....67

Figure 7. Pre Survey: Interest in using technology for testing……..68

Figure 8. Post Survey: Interest in using technology for testing……69

Figure 9. Pre Survey: Using audio support can improve performance……..70

Figure 10. Post Survey: Using audio support can improve performance……70

Figure 11. Opinion about losing marks by misreading questions or important words……...72

Figure 12. Opinion that reading as well as listening will improve individual test results…….....72

Figure 13. Pre Survey: I am a strong reader …….....73

Figure 14. Post Survey: I am a strong reader……73

Figure 15. Post Survey: My experience using the technology was positive…….74

Figure 16. Post Survey: Using the technology helped me to perform better on the test……...75

Figure 17. Post Survey: It was a satisfying experience to use the audio……..76

Figure 18. Post Survey: I would be interested in using text to speech or audio in future tests……76

Figure 19. Post survey: I lose marks without the benefit of audio when I write tests……77

Figure 20. Post Survey: Use of audio for provincial achievement testing……....79

Chapter One

Assuming that there is only one "right" way to learn—or to walk, talk, paint, read, and write—is the root of fundamental inequities.

~Thomas Hehir

Joshua's Story

Joshua shuffles along in the gathering line up for the exam. He is sweating slightly and breathing heavily as he pulls out identification to enter the secure examination room to write his final exam. Head lowered, hands fidgeting, Joshua tries to calm himself down. The chatter from the other students adds to his anxiety and thwarts his attempts to relax. As he shows his school picture at the door, Joshua can feel his heartbeat accelerate as a few beads of perspiration form on his forehead and his stomach starts to churn. The teacher quips some humorous statement but Joshua is too tense to respond. He believes the stakes are high because he has never really been great at writing tests and is actually panicked by the task that is ahead of him.

Joshua has managed to get through his high school courses with hard work, but his marks sometimes do not reflect the depth of his knowledge. He struggles when he writes tests, and often loses marks on questions that he has misread under the pressure of the test situation. As a responsible student, Joshua knows the material after spending hours and hours of studying, but he recognizes that is not enough because of past experiences of misreading questions which contributes to the anxiety he is feeling right now. Although not diagnosed with a reading disability, Joshua has a few issues with fluency that are exacerbated in an exam setting. Joshua's reading skills sometimes impacts his mathematics marks even though he has a "math brain" and is performing near the top of his class in that subject. Joshua's struggles with reading have not stopped his enthusiasm for learning and he frequently uses the

computer to research and study topics that interest him. He has discovered an open source screen reader that converts text to speech and this application has helped him tremendously. Having text read to him has enhanced Joshua's engagement in learning and he uses the screen reader almost daily on his home computer. Unfortunately, the screen reader is not available in his educational setting nor permitted during an exam. If only he could have ubiquitous access to the screen reader technology – he would find reading and learning so much easier and his anxiety about the reading tasks would be reduced. Joshua does not want anyone to know that reading challenges him and he wrestles through school activities that require it. In the gymnasium, Joshua looks out over the expanse of seats trying to locate where he needs to go and thinks to himself, "Why do I feel naked?"

For a variety of reasons, many students like Joshua feel vulnerable when they go into an exam room and when they have to demonstrate what they know through what Edyburn (2006) terms "naked independence". Simply stated, naked independence means that students are not given the opportunity to perform using tools or technology that may help them build confidence to better demonstrate their understanding of content knowledge. The present study builds on the vision that all students in Alberta deserve to learn and to be supported in their learning. Using technology may allow students to better demonstrate what they know. When students like Joshua go into an exam and underperform because the structure and/or the format of the exam is not supportive of their learning needs, then how they think about themselves as learners may be affected as is their potentiality (Ibid., 2006). We live in a time when technology can be readily used to better address learning preferences or needs and optimize any learner's ability to be successful. Although computers have

been in classrooms for a long time, opportunities for enhancing learning through the affordances of technology have been slow to permeate secondary schools especially in the area of assessment. As both a teacher and a researcher, I am passionate about exploring how technology may offer students, like Joshua, more options to demonstrate what they know and more opportunities to experience success in learning. This research focuses on the first steps toward alternatives to assessment practices that may presently create obstacles.

"Many students who fail in school demonstrate sophisticated competence in nonschool activities" (Bransford, et al. 2006, p. 25). Why are students often caught in the inextricable situation of holding sophisticated competency in non-school activities and at the same time not being able to demonstrate competency at school tasks? Is it because students have more choice outside of school and they focus the bulk of their energies on their strengths and interests? How does engagement impact this situation? What supports would make a difference? Could barriers to curriculum be part of the problem? What is happening pedagogically to create this dilemma? How can assessment better address students' learning needs? How can technology be used to create a better outcome? What does the research portray about this incongruence? Questions such as these led me to think carefully about my role as an educator, in particular, as a resource person for other educators and students. I am motivated to expand my own knowledge of research about diversity, learning and technology. My research goal is to address and/or minimize barriers for learners in assessment—to explore and to understand deeply one strategy that may increase student success when students are demonstrating their knowledge either in formative or summative assessments as well as large-scale provincial achievement tests and diploma exams.

Rationale

> *Engaging participants in the process of looking and then looking again at incidents or events with an eye toward rendering them critical triggered reflection, expanded the possibilities for knowing, and captured the dynamics of the complex educative contexts and the participants' relational practices.*
>
> *~ Halquist & Musanti, (2010), p.453*

Research is needed to seek greater understanding about how technology can influence current practice for large-scale assessments such as provincial achievement testing and diploma exams in Alberta (Almond, et al., 2010; Bolt, 2011; Dolan, Hall, Banerjee, Chun & Strangman, 2005; Feldman, Kim, & Elliott, 2011; Thompson, Johnstone, & Thurlow, 2002). Alberta Education (2011a, 2010b, 2009a, 2009b), the provincial education ministry is responsive to appropriate and timely research about technology and learning. Educational research that is able to increase understanding about how the use of multiple means of representation provides personalization and still meet accountability and security protocols on large-scale assessment may be valuable for the learning community.

In large-scale assessment, students' individual learning needs have been largely restricted to one approach to testing, multiple choice with text as primary mode of delivery that privilege those students with strong reading skills (Dolan & Hall, 2007). Providing large-scale assessment with the universal design principle of multiple representation better aligns with educational initiatives to consider diverse learning needs and may "make everyone's experience better" (Dolan & Hall, 2007, p. 96). Multiple means of representation, one principle of universal design for learning (UDL), offers students the opportunity to make individual choices of using text to speech or audio with the traditional print format may improve student motivation and engagement in some testing situations because it considers diverse learners (Dolan & Hall, 2007; Ketterlin-Geller, 2005).

This research seeks to provide new insights on whether the intentional coupling of assistive technology with exam writing practices to provide more than one alternative is a viable opportunity to meet the academic needs of a greater proportion of students while reducing the need for extended accommodations for particular students. Applying the universal design principle of multiple representation to all provincial tests and diploma exams "may help reduce the need for accommodations among students with disabilities" (Bolt, 2011, p. 4). Providing access to multiple representation for all students may improve learner outcomes and it can reduce teacher time spent on advocating for this access for the minority of students who qualify for access through meeting criteria for special accommodations.

This doctoral study is timely in response to Alberta Education's *Setting the Direction* (2009b) and *Action on Inclusion* (2010b) framework. The premise of the *Setting the Direction* framework is to "recognize and respond to disability and diversity *within* our education system by ensuring that educators, schools, and school authorities have the support they need to develop and deliver an inclusive education system" (Alberta Education, 2009b, p.5). The current one-size-fits-all perspective for standardized testing which mostly utilizes single representation is not inclusive and does not align with the ideas reflected in *Setting the Direction* (Alberta Education, 2009b). Enhancing large-scale assessment with at least one alternative to the print, such as text to speech or audio, supports the perspective that students do not all have the same learning abilities and needs.

Education is moving away from the historical perspective of the "factory model" of education "that conforms ideologically and structurally to the mass production model that powered the nation into the 20th century" (Van Duzer, 2006, p.11), where all students are expected to be in the same range as their grade and age

cohort for readiness and competency. Addressing diverse student learning needs also aligns with the *Inspiring Action on Education*, which has the vision that "includes every learner regardless of background, need or circumstance" (Alberta Education, 2009a, p. 8). Recognizing how technology can promote UDL in the area of assessment may be another opportunity to "enable more students to fulfil their academic and social potential" (Silver-Pacuilla, 2006, p. 9). This research can contribute to the building of knowledge about how to dismantle barriers in large-scale assessments.

Purpose of the Study

> *Pedagogy must be oriented not to the yesterday, but to the tomorrow of the child's development. Only then can it call to life in the process of education those processes of development, which now lie in the zone of proximal development*
>
> *~Vygotsky, 1993, pp. 251-252*

The purpose of this doctoral research is to explore how multiple representation on the grade nine Alberta provincial achievement tests in mathematics and social studies affects students' experience while writing the exam. What are students' perceptions of this experience? The present study builds upon the small body of existing research about using principles of UDL to facilitate greater accessibility in an exam environment for all students. Ideally, the findings from this research may influence how formal standardized assessments are conducted in the province of Alberta.

The grade nine provincial achievement testing occurs annually across the province every June and in some districts every January and June. This present study is not aimed at justifying the rationale for or against conducting large-scale standardized exams such as the provincial achievement tests or diploma exams in Alberta. There is copious research that can support using or not using large-scale

standardized assessments for a variety of purposes (Black & Wiliam, 2006; Herman, Baker, & Linn, 2009; Linn, 2000; Nagy, 2000; Sawyer, 2006; Vogler & Virtue, 2007). It is also beyond the scope of this study to challenge the format of these exams to include 21st century approaches such as multimedia representation or multiple assessment methods. Although multimedia may be developed for future large-scale assessment, this study is only considering how multiple representation through digital, audio and written formats might impact student experience.

Specifically, the present study considers how digital text with "screen voicing" capability or audio format, coupled with the written or digital format for textual information, provides options for accessibility for a diverse range of learners in any class, and not just limited to only those learners with identified disabilities. A question that frames this study is, what is the impact on experience if the test is offered with an audio format in addition to a written format to *all* grade nine students who are writing the provincial achievement test for social studies and mathematics? I wish to examine whether access to audio provides a notable difference for some students' experiences and perceptions of testing. Rather than having these supports only available through an application for special accommodations which may exclude some students and stigmatize others, all students could choose to access this assistive technology to suit their learning need and/or preference as a choice not as an accommodation. Alberta Education (2010a) posits, "one of the hallmarks of a differentiated instruction approach is providing learners with choices in how they interact with new information and ideas, practice skills and demonstrate what they know" (p. 93).

Significance of the Study

> *There are a vast number of ways that students extract understanding from written materials, and it is realistic to assume that not all students comprehend information in the same manner.*
>
> *~Campbell (2004, p.168)*

This study provides insight into using technology to support multiple representation for Alberta provincial achievement testing and may be of interest to those who are promoting UDL within classrooms in the province, those in educational technology and those involved in initiatives to promote personalized learning within Alberta Education. The findings from this study may lead to:

- a broadened perspective of potential barriers for all learners in large-scale assessment in the province
- clearer insight about assessing content material for exams
- better understanding of how educational technology can be used during standardized testing situations
- consideration for the possibilities available through the use of the UDL principle of multiple representation in classroom assessment
- recognition of individual learning needs and preferences related to test taking.

This study is expected to benefit:

- students who are challenged by the present single representation format of provincial achievement exams;
- students who presently can access supports but do not want to be considered "special" or to have a feeling of being stigmatized by a label
- educators, researchers and leaders involved in promoting UDL in Alberta schools

- educators, researchers and leaders who want to gain a better understanding of incorporating UDL into assessment

This study has the potential to contribute to the Alberta Education frameworks for *Inspiring Action on Education (2009a)* and *Action on Inclusion (2010b).* School jurisdictions may also be interested in the results of study to ascertain the impact of personalization of learning for students and the delivery format of standardized exams both now and in the future.

Research Questions

This research is guided by the following question:

How does access to multiple representation through an audio format, such as audio CD or text to speech, and written format affect students' satisfaction with writing the grade nine social studies and mathematics provincial achievement tests?

Secondary questions that frame this investigation include:

- How many students who did not already have diagnosed disabilities used the text to speech or audio?
- What were challenges with the process of carrying out the research?
- What were the celebrations according to participants?
- What were teacher insights about the process?

This dissertation is presented in five chapters. This chapter is an introduction to the study with the rationale, purpose of the research, research questions and

significance of the study. Chapter two is a review of the literature about diversity, technology affordances, theoretical perspectives of UDL, how UDL is not a euphemism for assistive technology, large-scale assessment in Alberta, promising practices, and large scale assessment coupled with UDL. Chapter three outlines the research design, the research methodology employed in this study, including the recruitment procedure and data collection methods. Chapter four presents an analysis of data from several sources. Chapter five is a discussion of the knowledge gained from the study while considering the trustworthiness of the data, the professional implications and the research question. There is also a discussion about how student views, teacher insights, challenges and celebrations integrate with the research question; one section considers alternatives that may have influenced the study. The fifth chapter concludes with the generalizability of findings, limitations, recommendations for research and recommendations for future practice.

Chapter Two

LITERATURE REVIEW

Practical uses for technology are ubiquitous and change the landscape for a myriad of functions and routines recreationally, medically, professionally and academically. Technology is used to monitor heart rate, complete online banking, buy music, communicate ideas, read global news, track social media, "write" papers and conduct research. Research into how universal access to assistive technology for assessment is important for establishing evidence about how technology can be used to better meet the diverse needs of learners. Increasingly technology is providing new ways of accessing universal design by using a flexible medium that may better address individual preferences for learning through using multiple ways of representing concepts; this development is particularly exciting, since not all students can master concepts or demonstrate their actual knowledge in the traditional textual form often used as the primary tool for learning and assessing (Edyburn, 2006; 2011; Jackson, Harper & Jackson, 2006; Johnstone, 2003; Meyer & Rose, 2005; Rose & Meyer, 2002; Silver-Pacuilla, 2006; Thurlow, 2010). The use of technology coupled with the extant knowledge about how people learn may create more student satisfaction with the school experience and encourage lifelong learning. Technology affordances create opportunities for learning that were not possible or too cumbersome in the past.

For the past century the prevalent models of schooling have been based upon the industrial revolution with ideas of what makes a factory work (Callanhan, 1962; Collins & Halversont, 2010; Friesen, 2009; Sawyer, 2006). Schools were heavily influenced by business values of efficiency, which contributed to the design of the school day and the curriculum to "make education more practical to serve a business

society better" (Callahan, 1962, p. 18). The industrial model of schooling includes standardization, grading, and curriculum development that parcels out knowledge "into systemized and bureaucratized school subjects" (Pinar, Reynolds, Slattery & Taubman, 1995, p. 71). Students were expected to respond to and be measured in the same way with the same tools such as standard instruction, standard conditions, standard schedules and standard tests that could be measured quantitatively to ensure efficiency (Callahan, 1962). According to Alberta Education (2009a), within the province "it is fair to say that schools still use elements of the industrial model", however, the goal is to transform thinking about education and how educators can support student potentiality (p.11). Historical practices may have been viewed as best practices during and for that time; however, given constant advances in educational research and technology, it is imperative that we keep studying teaching, learning and assessment practices given the new knowledge and understandings achieved through present research and with the advancement of current technologies. Research can help to support the goals of transforming thinking as it provides knowledge to promote change (Friesen, 2009).

Conducting research into how educational technologies can be designed and used to influence current teaching and learning practices is imperative to keep abreast of current knowledge and also to generate new knowledge (Almond et al., 2010; Edyburn, 2007; Jackson et al., 2009; Januszewski & Molenda, 2008; Meyer & Rose, 2005; Silver-Pacuilla, 2006; Thurlow, 2010; Thompson et al., 2002). Marrying technological innovations with emerging educational practices can influence student learning and potentiality (Almond et al., 2010; Edyburn, 2006, 2007; Jackson et al., 2005; Pellegrino & Quellmalz, 2010; Rose & Dalton, 2009). Friesen (2009) maintains that although we do not have all the right answers for transforming education, it is

important to ask the right questions as we rethink education with the background of what we now know about learning. The current research is positioned in the intersection of research on educational technology, emerging learning and assessment research, especially that related to large-scale assessment. This case study provides the opportunity to better understand the relationship between these three areas and the impact on student experiences with Alberta provincial testing in mathematics and social studies.

Technology Affordances

> *… the use of technology does not—in and of itself—improve the learning process, but [the] focus is to use technology to enhance the learning process as defined by UDL principles.*
>
> *Morra & Reynolds, 2010, p. 44*

Helping people to learn more effectively is the primary and essential purpose of educational technology (Januszewski & Molenda, 2008). Januszewski and Molenda (2008) present the definition of educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (p. 1). Facilitating learning means intentionally bringing together learning and instructional design theory in the design and study of promising, technology-enabled practices to build insights about assessment practice, all in service of designing and supporting better learning environments and experiences (Januszewski & Molenda, 2008). The ongoing evaluation cycle includes formative and summative assessment in technology-enabled environments across multiple contexts, with diverse learners who bring unique learning characteristics to the learning experience.

Pellegrino and Quellmalz (2010) posit that we are in the beginning stages of understanding and planning to adequately use technology for assessment. Facilitating improved performance means creating opportunities for students to access technology to demonstrate learning without having to be restrained by the traditional practice of one size fits all such as pen and paper exams (Edyburn, 2006). Since technology affords more opportunities to customize learning tasks including summative assessments, it may offer potential by providing multiple access points for learners during formal assessment (Almond et al., 2010; Pellegrino & Quellmalz, 2010; Thompson, Johnstone & Thurlow, 2002).

Johnstone (2003) states that although UDL is relatively new this perspective about designing learning is being referenced in assessment literature and is part of policy in some states in America. In the American report *National Center on Educational Outcomes,* Johnstone (2003) described the results of a mixed method study to build understanding of how construct irrelevance in reading impacts students through researching consideration about the difference between traditional assessments and universally designed assessments. The 231 participants for the research were assigned into two studies – one that used a control test and an experimental test that utilized UDL and the second study was a qualitative analysis of student experience on two versions of the test. Both studies illustrated that students found UDL principles helped with student performance (Johnstone, 2003).

Research findings like Johnstone's (2003) lead us to ask how can we design more accessible assessments using assistive technology to provide options for students in managing their own learning needs and learning preferences while writing exams. For example, if students use "screen voicing", the computer is not reading the exam to them, the program is merely voicing the content on the screen to provide an

option to access (Rose, 2011). Utilizing assistive technology to provide audio format or text to speech affords more options to support individual student needs and the "diverse ways of recognizing, strategically interacting, and engaging with an assessment" (Dolan et al., 2005, p. 8). Students need to understand the question, whether written or voiced, in order to perform the task being assessed. Typically the "how" of students' access to exams is not part of the assessment consideration or design although historically this access is mainly through text (Dolan et al., 2005; Rose, 2011). Edyburn (2007) posits that assistive technology can improve performance in assessment and "challenges traditional entitlements held by those who can complete a task and claim that their performance is superior to the performance of those who must rely on technology" (p. 151).

Technology may enhance the feasibility of all three principles of UDL: multiple means of representation, engagement and expression (Edyburn, 2010; Hehir, 2011; Lapinski, Gravel & Rose, 2012; Pisha & Stahl, 2005; Rose & Dalton, 2009; Rose & Meyer, 2002). Almond et al. (2010) describe four different ways that tests can be made more accessible through technology, which align well with the principles of UDL:

> 1) flexibility in presentation;
> 2) flexibility in how the student engage with test content;
> 3) system compatibility with assistive technologies, and;
> 4) alternative representations (p. 19)

This study examines specifically how multiple representation unlocks the potential to dismantle traditional barriers that can be associated with "print only" exams by offering all students at least two points of access to support their individual needs and preferences (Messinger-Willman & Marino, 2010; Rose & Dalton, 2009; Stahl, 2003). By universally offering different points of access, teachers would not need to figure out which support goes to which student since students would have the

option to choose. Students could use individual computers or personal devices that may have the potential to suit specific needs with supports such as audio access that are "embedded universally, but displayed individually" (Rose & Dalton, 2009, p.79). This kind of alternative representations is not yet available to most students in the province when they write provincial achievement tests.

Although copyright agreements restrict the use of digital resources utilized by the Alberta Education to those students with diagnosed learning needs, work is being done to work toward gaining the right to use digital text with audio options for any student in the province (Alberta Education, 2009b). The present research contributes findings from Alberta classrooms to the conversation about providing the right to use digital text with audio options for any student. Having access to an digital audio version or text to speech along with the printed format for all students in large scale assessment may be more conducive to meeting the learning needs and preferences of all learners, and thus improving experiences and outcomes with exams.

Diversity

> *One of the clearest and most important revelations stemming from brain research is that there are no regular students. Instead learning is as unique to individuals as their fingerprints. The notion of broad categories of learners—smart-not smart, disabled-not disabled, regular-not regular—is a gross oversimplification that does not reflect reality.*
>
> *~Hall, Meyer & Rose, 2012, p.2*

Alberta Education (2010a) supports inclusion and, like many other provinces, strives to ensure that all students receive a "quality education" while fostering a sense of belonging for all students within the school. Schools in Alberta are encouraged to use a number of approaches and perspectives to respond to the diverse range of learners in classrooms such as UDL, technology (including assistive technology), differentiation, and flexible groupings (Alberta Education, 2010b). The theoretical

perspective of UDL promotes that teachers design and support effective learning environments for diverse students by bridging the rigidity of conventional one-size-fits-all curricula (Hall, Meyer, & Rose, 2012; Meo, 2008; Meyer & Rose, 2005). "[UDL] rests on a belief that designing for diverse learners results in better learning outcomes for all individuals" (Coyne, Pisha, Dalton, Zeph & Smith, 2012, p. 163).

UDL is rooted ontologically in diversity as a fundamental premise. People are different from each other and they learn in different ways. The ideas of diversity have ecological origins, and diversity is not a problem to be overcome, it is just the way people are. Diversity describes the many types of learners in a classroom including students from different cultural backgrounds, different languages, different educational opportunities as well as students with diagnosed learning needs including sensory, behavioural, physical, learning and cognitive differences. These learners, an inherent part of inclusive classrooms communities, have myriad learning needs and aspects of the learning environment may be challenging unless this diversity is acknowledged and addressed. The varied impact of the learning environment on learners is particularly true when students are expected to fit the curriculum and not vice versa. The accumulating research about diversity in classrooms and the underlying complexities illuminated from the research need to be addressed in both instruction and assessment (Almond et al, 2010; Hehir, 2005; Edyburn, 2006; Hitchcock, Meyer, Rose, & Jackson, 2006; Jackson, Harper, & Jackson, 2005; Lopes-Murphy, 2012; Meo, 2008; Messinger-Willman & Marino, 2010; Meyer & Rose, 2005; Thurlow, 2010; Thurlow, Johnstone, & Ketterlin-Geller, 2008). Research about the inclusion of diverse students including those with identified disabilities has strengthened the belief in the value of inclusion to the individual student and to

society, which supports the organic nature of diversity (Alberta Education, 2010a; Hehir, 2005; Hitchcock et al., 2006).

Studies about the principles of UDL demonstrate that a learning environment has the potential to be more successful for all learners when it is set up to meet the diversity typical to most classrooms (Hall et al., 2012; Hehir, 2005; Lopes-Murphy, 2012; Marino, 2009; Meo, 2008; Rose, Meyer, & Hitchcock, 2005). UDL researchers reject the notion that one-size-fits-all in a classroom, encouraging instead, multiple means of engagement, representation, and expression (Jimenez, Graf, & Rose, 2007; Meo, 2008; Morra & Reynolds, 2010; Rose & Meyer, 2002; Rose, Meyer et al., 2005). The three principles of UDL:

- Principle 1: To support recognition learning; provide multiple, flexible methods of presentation.
- Principle 2: To support strategic learning, provide multiple, flexible methods of expression and apprenticeship,
- Principle 3: To support affective learning provide multiple, flexible options for engagement. (Rose & Meyer, 2002, p. 75)

UDL may reduce the need for extra accommodations or modifications not through reducing the learning standards but by diminishing the barriers that may interfere with learning (Hitchcock et al., 2002; Lapinski et al, 2012; Rose & Meyer, 2002). This would mean that all learners can interact with the curriculum through multiple means for accessing information, for demonstrating knowledge and for engaging in the learning tasks and activities (Rose & Meyer, 2002). The hallmark of UDL is creating flexibility in the curriculum that will benefit all learners "including those whom the innovations were not explicitly intended to help" (Meo, 2008, p.22).

When assistive technology, such as text to speech, is made universally available in a learning environment, all learners have the option to choose to use the resource to alleviate challenges with accessing print or to suit learning preferences, not just those with an identified learning need (Rose & Dalton, 2009). With the

explosive development in digital media, the textbook which historically has been the main source used in learning content, does not need to be the single point of access (Rose & Dalton, 2009; Rose, Harbour, Johnston, Daley & Abarbanell, 2006; Stahl, 2003). Ever increasing online sources such as multimedia encyclopaedias, blogs, interactive education sites, podcasts, video sites with animated presentation of concepts, peer perspectives, as well as lecture clips from experts have been found to support diverse ways for learners to engage with curricular concepts. Teachers do not need to be the sole purveyor of knowledge or just use textbooks; with universal designs and appropriate technology, teachers can help learners to engage with information and build knowledge through exposure to multiple representation of concepts, including expert sources available through online and global connections.

Action on Curriculum (2011a), *Setting the Direction (2009b), Inspiring Action on Education (2009a)*, and *Action on Inclusion (2010)* are examples of provincial initiatives that illustrate Alberta Education's commitment to transform education in the province to align with current research about how individuals learn and to support diversity in the classroom. Research has illuminated that UDL has been instrumental in creating opportunities for all learners to experience success in learning (Coyne et al., 2012; Edyburn, 2006; Hitchcock & Stahl, 2003; McGuire, Scott, & Shaw, 2006; Meo, 2008; Parette & Peterson-Karlan, 2007; Pisha & Coyne, 2001; Rose & Meyer, 2002) and it has "captured the imagination of educational leaders and policy makers as a promising practice for enhancing the educational achievement of an increasingly diverse student body" (Edyburn, n.d., p.2).

The shoulders that support UDL

UDL has a number of theoretical underpinnings necessary for credibility (Rose & Meyer, 2002). The confluence of ideas about learning approaches, theories of learning, accessibility, neuroscience research and technology applications support the theoretical perspective of UDL to address "designing curricula—that is, educational goals, methods, materials, and assessments—that enable all individuals to gain knowledge, skills, and enthusiasm for learning" (CAST, 2012, para. 1).

Research on cognitive neuroscience and education provided insight for establishing UDL principles, according to Rose and Meyer (2002). Brain research, as it relates to learning, is flourishing which will continue to influence educational practice and policy (Bransford et al, 2006; Fischer, 2009; Fischer et al, 2010; Worden et al, 2011). Fischer, Goswami and Geake (2010) espouse that the field of neuroscience is contributing to "understanding the diversity of abilities and disabilities [which] will help educators and parents to facilitate individual students' learning and development" (p.68). According to Bransford et al. (2006) there are a number of reasons cognitive neuroscience furthers understanding of learning. First it provides more understanding about the "how and why" of learning not just that learning is happening. Second the newer imaging technologies are more informative about how the brain responds to different learning activities and tasks. Third, these neurological measures of brain activity can provide further insight into individual differences (Bransford et al., 2005, p. 20).

Luria (1973) conjectured that there was evidence "for distinguishing three principal functional units of the brain whose participation is necessary for any type of mental activity" (p. 43). The principles of UDL are connected to Luria's work about three large brain units (Rose & Meyer, 2002). The recognition network or "the what"

of learning, the strategic network or "the how" of learning, and the affective network or "the why" of learning each contribute to building knowledge (CAST, 2012a). Luria's theory of the brain and learning was used in advancing an understanding that each of these networks needs to be addressed to create optimal learning (Rose, 2011). Part of the diversity of learners comes from the nuances in the brain and "how 'modularized' the brain" is with "a large number of such distributed modules that work 'in parallel' each highly specialized for learning about specific aspect of the world" (Meyer & Rose, 2006, p. 2). Rose & Dalton (2009) posit that all human brains are unique with distributions of strengths and weakness throughout each network. This research illuminates the idea that "variation is not only universal, it is ubiquitous" (Rose & Gravel, p. 3).

A critical idea for the development of UDL was universal design in architecture, which started in the 1970s to address issues with inaccessible buildings that required retrofitting in order to allow people with mobility issues to gain access (Hitchcock & Stahl, 2003; Jimenez et al., 2007). Ron Mace, an architect confined to a wheelchair, conceived the notion of "universal design" by creating universal access at the design phase of the building. Although the original idea was to provide access to those in wheelchairs, very quickly it was observed and became well understood that many others benefited such as those with strollers or delivery carts (Mace, Hardie & Place, 1996). As new buildings were designed and built, developers understood that planning a universal design in the beginning made more sense than trying to accomplish it as an afterthought since possible barriers to accessibility were considered and removed if necessary before major construction began. This approach to universal design neutralized major obstacles such as stairs or doorknobs.

CAST visualized the benefit of utilizing Mace's concept of universal design in classrooms to consider the curricular not physical barriers (Rose & Meyer, 2002). When universal designs in the physical environment work well, they disappear into the environment since they are not noticeable (Pisha & Coyne, 2001). The elevator at the Louvre in Paris is an incredible example of universal design. It looks more like art than a design to help accessibility. Applied to learning, universal design should also be invisible and ubiquitous as it becomes a fluid part of how learners interact with the curriculum that has accounted for potential barriers ahead of time. Consideration for universal design of curricula from the beginning, to meet the needs of many learners instead of just the mythical "average student", reduces the burden of having to "retrofit" curriculum after the fact.

CAST draws on the work of Vygotsky in building the vision of UDL. Vygotsky (1978) advocated that learners need environments that permit the construction of learning through engagement with sensory data. The "zone of proximal development" as defined by Vygotsky (ibid) is the "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Vygotsky's ideas about the zone of proximal development and engagement are important to the UDL theoretical perspective as these ideas inform teachers about the benefit of using multiple means to "scaffold" learning and sense-making for diverse learners. "There is no single zone for any individual; zone changes from one domain to another and from one minute to the next" (Fullan, Hill & Crevola, 2006, p. 33). The founding members of the CAST were influenced by Vygotsky's theory of learning on social constructivism in their development of the principles for UDL. When students are

given an opportunity to advance their potential with support, they can be taught beyond what they can achieve independently (Vygotsky, 1978).

CAST's work with diverse learners also aligns with Gardner's (1999) theory of multiple intelligences. Gardner (1999) posits that considering individual intellectual needs will help learners be more successful than environments where everyone is treated as though they all have the same learning needs. This perspective that planning curricular goals should go beyond "one size fits all" affords opportunities for success for many learners (Messinger-Willman & Marino, 2010; Meyer & Rose, 2005; Rose & Meyer, 2002,). Gardner (1983) reasoned that using a variety of media helps all learners with knowledge building, which is related to the UDL principle of multiple means of representation.

Differentiated instruction began as a way to deliver better education for gifted students in a typical classroom by providing differentiated activities that would challenge that specific group and slowly grew to support diverse learners (Hall et al., 2003). UDL began from a special education perspective of figuring out the best way to make a learning environment accessible to learners at the beginning stages of the curriculum design (Hall et al., 2003). Although not identical, differentiated instruction also aligns with UDL through compatible understanding about the differences in learning. Differentiated instruction, like UDL, can create opportunities for learning by recognizing that individuals, even if they are of the same age or in the same grade, are not all at the same place in their learning (Hall, Strangman, & Meyer, 2003).

Differentiated instruction is a strategy to meet the needs of a wide variety of learners through modifying curriculum and adjusting teaching approaches, groupings and activities throughout the unit of study to meet specific individual variance in readiness (Tomlinson, 2001; Tomlinson, Brighton, Hertberg, Callahan, Moon…and

Reynolds, 2003). Teachers would use assessments at the beginning of the unit to identify activities and groupings for particular students and then ongoing assessment to make changes when necessary "in response to particular need of particular [students]" during the course of learning (Tomlinson, Brimijoin, & Narvaez, 2008, p. 5). According to Tomlinson (2001), differentiation is about good teaching and holds to three principles: "intelligence is multifaceted..., intelligence is fluid..., and vigorous learning changes the physiology of the brain" (p. 18). Differentiating instruction helps teachers to maximize learner growth by taking students with differing abilities from where they are in the learning process and building individual capacity to move forward in response to student variations in "readiness, interest and learning profile" (Tomlinson, 2008, p. 11).

Another theoretical underpinning for UDL is educational technology. Coupling technology with the UDL perspective upholds the purpose of educational technology in facilitating learning and building student capacity. Januszewski and Molenda (2008) see the possibility to "envision an eclectic umbrella" of technology use that can help provide environments conducive to engaging learning. Pellegrino and Quellmalz (2010) assert that the use of technology in educational settings "will continue to impact the world of education in powerful and provocative ways" (p. 131). The technological resources available today may support deeper learning by helping all learners engage with the world's knowledge through different representations, by allowing learners with diverse abilities to represent their thinking and knowledge building in a variety of ways, by supporting reflection and sharing, and by making collaboration with learners and expertise beyond the classroom more readily available.

UDL is not a euphemism for assistive technologies

There is a need to differentiate between UDL and assistive technology, because while related, the two ideas to supporting learning have important differences. The definition of assistive technology established by IDEA (2004) as "any item, piece of equipment, or product system, whether acquired commercially, off the shelf, modified, or customized, that is used to increase, maintain or improve the functional capabilities of a child with a disability" (20 U.S.C. § 1401(251)) provides guidance about what is considered assistive technology for classrooms. In Alberta assistive technology for learning is defined as "the devices, media and services used in learning environments to overcome barriers for students with physical, sensory, cognitive, speech, learning or behavioural special needs to actively engage in learning and to achieve their individual learning goals" (Alberta Education, 2011b, para. 1).

The primary purpose of assistive technology in the classroom is to alleviate specific learning issues that impact access and originally came from the idea of providing "fixes" so that the learner might better fit in by helping him or her adapt to the environment (Meyer & Rose, 2005; Rose et al., 2006). For example, it has been successful for providing bridges to learning like converting text to braille or read aloud for blind or low vision students. Assistive technology has also given individuals with physical limitations the opportunity to use software or devices to complete required work through adaptations such as speech to text if fine or gross motor ability limits mobility to use one's hands. However, research has shown that the notion that a core group of students in a class would be homogenous and only students with identified needs would benefit from assistive technology is misguided (Hitchcock et al, 2006; Rose et al., 2005). Considering research from the perspective of UDL, these assistive technologies have also been found to be beneficial for other

learners who are not identified as requiring specialized learning tools since "myriad subtle differences make each learner unique" (Hitchcock et al., 2006, p.54).

As much as the various assistive technologies benefit students with specialized needs, when they are incorporated into a classroom for all, these technologies also promote universal design (Edyburn, 2011; Jackson et al., 2003; King-Sears, 2009; McGuire et al., 2006; Pisha & Coyne, 2001; Rose, Hasselbring et al., 2005; Rose & Dalton, 2009). Access to assistive technology for all learners may also reduce the stigmatization of individuals with special education needs since universal access supports the continuum of the diverse learners, which may change the perception about why a person is using assistive technology. Universal access is particularly important since "academic performance problems are not limited to students with disabilities" (Edyburn, 2010, p. 39).

According to Rose, Hasselbring, Stahl and Zabala (2005) there may be confusion that assistive technology and UDL are "identical or conversely, antithetical" and argue instead that they are concomitant "much like two sides of the same coin" (p. 507). Basham, Israel, Graden, Poth and Winston (2010) calls the relationship between assistive technology and UDL "symbiotic" with one not more important than the other and both able to function in the same learning environment. Based upon the operational uses of assistive technology and UDL, each contribute to creating circumstances where learners may have more opportunities to perform at their potential ability levels (Hall et al., 2003; Hitchcock, 2002; Edyburn, 2007; King-Sears, 2009; Marino, 2009; Rose & Dolan, 2006; Rose & Meyer, 2002; Thurlow, 2010). Rose, Hasselbring, Stahl, & Zabala (2005) posit that UDL and assistive technology may be viewed as "existing on a continuum" where they are markedly

different at each end but in the middle they are less distinctive as they are both are intertwined to facilitate learning for the same population of students.

Universal access to assistive technology honours human diversity by providing the "ramps and the stairs" which offers choice to all (Rose, 2000). However UDL is more than just access. Rose and Gravel (2012) suggest, "while providing access to information is often essential to learning, it is not sufficient…the pedagogical goals, methods, materials and assessment of instruction—are also accessible" (p.7).

UDL, which often includes assistive technologies, is not a euphemism for assistive technologies or web accessibility. UDL encompasses a broad perspective of accessibility that "describes an environment where access is equitably provided to everyone at the same time" (Edyburn, 2010, p. 34). UDL is more far reaching than assistive technology in terms of the influence on all learners (Hehir, 2005; Rose & Meyer, 2002; Hall et al., 2012), since UDL "focuses on a holistic approach to curriculum development" (Messinger-Willman & Marino, 2010, p. 8). UDL encompasses all aspects of the learning environment, from pedagogical goals, instructional methods, selection and provision of learning materials and resources, consideration of classroom spaces, characteristics of learners, to the development of curriculum.

Misconceptions of UDL

A possible misconception about UDL is that universal design means one size for everyone with the notion that universal means one way (Hall et al., 2012; Rose, 2000). The term universal can be perceived as general or nonspecific, which may be confusing. CAST's mission for UDL is the opposite of one size through provision of

alternatives for “fair access” that are inclusive because of the flexibility to meet different needs (Hall et al., 2012; Rose, 2000).

When teachers incorporate principles of UDL in their instructional designs, it requires them to rethink the possibilities of how learners engage with knowledge and with each other, how learners express and represent their ideas and understand with each other and how to authentically assess learning while it happens as well as the learning products created. Changes are required of teachers in their instruction and their assessment of learning—which may create tension, anxiety, some push back. When educators recognize the possible range of diversity that may be present, yet not readily visible, and then establish goals where learners are able to participate since designs are student centered and customizable for all students, it require thinking with a different perspective about what may create barriers and how to make curriculum universally accessible (Rose & Gravel, 2012).

Edyburn (2010) and Meo (2006) highlight another misconception that UDL is just good teaching. This could hinder incorporating UDL into a learning environment since educators may believe that nothing in the environment needs to change if they are already good at teaching. UDL requires a transformation in how the curriculum is delivered through the use of innovative pedagogy without reducing the standards for established curriculum goals and without modification for specific students since UDL perceives the disability to be in the curriculum not within the student which is not about good teaching but about recognizing and reducing barriers (Lapinski et al., 2012; Meo, 2008; Rose, Meyer, et al., 2005; Rose, Gravel & Domings, 2012).

One could argue that UDL is difficult to sustain without the benefits of technology because it affords ease with utilizing the principles. Technology certainly reduces many time-consuming preparations, but it does not necessarily change

pedagogy (King-Sears, 2009). Use of technology for all students or assistive technology for students with special needs does not guarantee that UDL is being utilized (King-Sears, 2009). UDL encompasses more than technology through a deeper understanding how the brain learns.

A misconception that UDL will override any need for continuing special education is inaccurate (Basham et al., 2010; McGuire, Scott & Shaw, 2006). Although many view disability on a continuum of human diversity, UDL is not meant to be a "magic bullet" that reduces the need for continued research and support of special education (McGuire, et al., 2006). UDL may seem overwhelming but McGuire, Scott and Shaw (2006) argue that UDL is not about meeting all needs all of the time and "to have realistic expectations of its paradigm in educational settings" (p. 172). There will be students who have very specialized needs which require additional supports that would not always be a part of a regular classroom.

With the continued research about UDL, evidence is being compiled to support educational systems incorporating universal design (Hehir, 2005; Marino, 2009; Jiménez et al., 2007; Meo, 2008; Rose et al., 2006). Potentially every learner could benefit from intentional changes that remove unnecessary barriers to performance. UDL is not about reducing the standards; it is about reducing the barriers that often misrepresent what a student can learn or demonstrate by providing 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" (CAST, 2012a, para. 2). It should be an integral part of instructional planning and implementation of learning environments to address the diversity of learning needs. UDL promotes individual growth not group ranking (Davies & Williams, 1997; Edyburn, 2006).

This is a different view than the traditional idea that all students need to be measured by one scale that ranks students.

UDL allows broader access to curriculum content by providing students with opportunities to master concepts with greater success and to demonstrate this learning with greater success than traditional educational practices (Edyburn, 2006; Hehir, 2005; Jiménez et al., 2007; Meo, 2008; Morra & Reynolds, 2010; Rose et al., 2006). Jiménez, Graf and Rose (2007) posit that since teachers need to design learning for a variety of students with and without disabilities planning for all learners through a universal design is "a very plausible and necessary alternative" (p. 51). Morra and Reynolds (2010) espouse that a UDL perspective creates more flexibility than a conventional perspective since students can use multiple ways of engaging in their learning with the understanding that there is more than one way of learning. Meo (2008) posits that it is necessary to determine the barriers that may exist in curriculum and then consider universal design that "enable all kind of learners to access and progress in the curriculum" (p. 22). Meo (2008) affirms that when teachers can see the difference that UDL can make, their perspectives about student capacity can change. The confluence of educational technology and principles of UDL has expedited this trend towards broader access to curriculum since curriculum can be more readily tailored to meet individual needs through the use of diverse media and technology means of communication, connection and visualization.

UDL and Large-Scale Assessment

> *The UDL principle of using multiple means of representation can go a long way in creating more flexible learning environments for all learners.*
>
> *Morra & Reynolds, 2010, p. 46*

Experts in the field recognize the scarcity of research in the area of universal design of assessment and want to "stimulate research into technology-enabled assessments that incorporate conditions designed to make tests appropriate for the full range of student population through enhancing accessibility" (Almond et al., 2010, p. 6). The present research addresses the scarcity of knowledge in the area of universal design for large-scale assessment.

According to Johnstone, Thompson, Miller and Thurlow (2008), the goal of all improvements to assessments, including incorporating UDL, is to increase validity. Are the results valid, when students who have diverse learning needs write exams that do not account for individual needs? Proponents of UDL argue that conventional assessments, frequently one-size-fits-all and single medium with reduced supports, may confound results (Rose & Meyer, 2002). Large-scale assessments do not recognize individual differences, and accommodations, including assistive technology, are "post hoc" and usually available only to students who have diagnosed disabilities (Rose & Meyer, 2002). The theoretical underpinnings that support UDL as a viable perspective to transform teaching and learning in the classroom may provide similar support for the more formalized large-scale assessment (Dolan et al., 2005; Johnstone, 2003; Tucker, 2009) which may improve validity. Although research is in the early stages, findings are promising that all students may benefit from assessments with universal design principles (Dolan et al., 2005; Johnstone, 2003).

Departments of Education, including Alberta Education, support the use of assistive technology for students who qualify through application to special accommodations departments and these accommodations are meant to "level the playing field" in reducing fundamental barriers imposed by the one-size-fits-all (Parette & Peterson-Karlan, 2007; Alberta Education, 2011a). Assistive technology

usage in large-scale assessments is viewed as compensatory for students with disabilities (Parette & Peterson-Karlan, 2007) and is not available for all students. It is not a perfect solution for any student since the exam itself may have more barriers than can be addressed through a specific assistive technology and there is no recognition of imperceptible barriers that may be alleviated with universal design (Ketterlin-Geller, 2005; Thompson et al., 2002). Implementing UDL reduces the amount of accommodations required thus reducing the concerns around "fairness" since all students have access to supports (Thompson & Thurlow, 2002).

Construct irrelevant variance, an uncontrolled variable that interferes with the content being tested that may influence scores, has always been a consideration for standardized exams (Chudowsky & Pellegrino, 2003; Dolan et al., 2005; Haladyna & Downing, 2004; Johnstone, 2003; Messick, 1989; Thompson et al., 2002). Barriers that interfere with a student being able to access material may impact validity of results (Beddow, 2011; Haladyna & Downing, 2004; Messick, 1989). The biggest construct that interferes with all testing is *readability* since it is used in most testing situations (Chudowsky & Pellegrino, 2003; Dolan et al., 2005; Haladyna & Downing, 2004; Johnstone, 2003). Using assistive technology in a universal design may better address the learning needs and styles for students who are likely in need of support, but do not qualify, or might not want to be singled out for attention, or who might not seek this help.

If the goal is to test reading skills especially fluency or decoding, then text to speech or audio support would undermine the task, but if the task is to test science concepts or social studies knowledge, then read aloud software or other audio version may enhance the opportunity for a student to demonstrate what they know without fluency or decoding skills interfering (Edyburn, 2006; Ketterlin-Geller, 2005; Meyer

& O'Neill, 2000). Large-scale assessments in subjects such as social studies or mathematics have the goal of testing content knowledge—therefore, exams in these curricular areas hold promise for removing the construct irrelevant variant of reading skill.

Dolan and Hall (2001) propose that utilizing universal design in assessment minimizes construct-irrelevance. This may potentially help diverse students who would be compromised by one-size-fits-all. Capitalizing on assistive technology in a universal manner by providing it for all students for assessments aligns with the principle of multiple means of representation.

Ketterlin-Geller (2005) defines UDL for testing as "an integrated system with a broad spectrum of possible supports" that more readily recognizes the diverse needs of students (p. 5). Almond et al. (2010) posit that two steps need to be considered in created universally designed large-scale assessment:

> first, test content must be developed in a way that anticipates the different representational needs of students and representational forms that meet those needs without violating the test construct and second, the system employed to administer test items to students must be designed to flexibly alter the presentation, interaction and response to items and tailor access to alternate representation based on students' individual need. (p. 11)

Almond et al. (2010) assert that complexities of the interaction between student and assessment are not fully understood and require further research. Thompson, Johnstone and Thurlow (2002) expect that universal design will influence large-scale assessments with continued research on innovation in this area. Experts argue that affordances using new media technology with assessments that are universally designed will allow better evaluations without reducing standards (Rose & Meyer, 2002; Salend, 2009; Tucker, 2009). "As universal design principles are increasingly applied to test development, accommodations will be integrated at the test design

phase and made available to a wide range of students" (Almond & Karvonen, 2007, p 134).

Large-Scale Assessment in Alberta

> *UDL encourages students to learn in the way that is most efficient and effective for them. If we teach students to be efficient and effective learners, we need to evaluate them in the same way.*
>
> *~Thomas Hehir, 2009, p. 6*

UDL cannot be considered without taking assessment into account (Rose & Meyer, 2002). In *Making a Difference*, Alberta Education (2010a) is supportive of applying the principles of UDL through the promotion of differentiated instruction to meet diverse learning needs. School districts within Alberta are working toward incorporating UDL, yet large-scale assessments do not recognize the diversity of learners. According to an educator from Alberta Education (personal communication, November 2011), some schools have been involved with using Quest A+, which is a web interface for test writing, but at the time of this study Quest A + did not provide audio or text to speech options. Options such as text to speech or audio are not available without application for special accommodations. In this doctoral research, the argument is that the incorporation of aspects of the UDL principle of multiple representation, specifically that of digital text with text to speech or other audio version offers a promising beginning of alternatives to standard single format pen and paper testing.

In Alberta, provincial achievement testing is customary and compulsory in grade three, six nine and then provincial diploma exams in grade 12. This is what provincial achievement testing looks like for the majority of students in grade nine—text only, with a few graphs or cartoon depictions and multiple-choice questions. One-size-fits-all is the general format. All students, unless granted specific

accommodations, need to read in order to complete these tests. Although supports are currently available for students who have diagnosed learning needs through an individual program plan (IPP) established to address these needs (Alberta Education, 2011c), this approach of providing support does not capture the diverse range of learners. This approach can negatively impact many students who, for a variety of reasons, may not be challenged by the content of the subject, but may be challenged by the reading (Dolan et al., 2005; Haladyna & Downing, 2004; Johnstone, 2003; Messick, 1989). For example, students who have stronger auditory skills may benefit more from listening than reading. A weak reader, not diagnosed with a reading disability, who often manages in regular activities, may perform more poorly in a formal exam environment when the weak reading skills are combined with the anxiety created by an exam or the rigid time structure common to formal exams. If a student has not been diagnosed with a disability, he or she may not qualify for an accommodation to access multiple representation for the exam, and just has to struggle through as best he/she can.

The variance of achievement results may not reflect the true learning that has occurred for individual students if they are having difficulty with reading the exam (Dolan et al., 2005; Haladyna & Downing, 2004; Messick, 1989; Rose & Dolan, 2006). With multiple means of representation on the achievement test to provide alternatives to the print format, performance may more accurately represent student knowledge (Dolan et al., 2005; Pisha & Coyne, 2001; Johnstone, 2002) since this process would intentionally scaffold student diversity for "recognizing, strategically interacting and engaging with assessment" through "multimodal access to test content" (Dolan et al., 2005, p. 8).

Promising Practices

> *Many students who struggle to learn lose confidence, anticipate failure and fail to fully engage the learning task. UDL must provide some latitude for learner choice and offer a range of instructional approaches, supports, and scaffolds.*
>
> *~Pisha & Coyne, 2001, p. 198*

Assistive technology offers promise by providing new ways of creating educational opportunities including curriculum delivery and assessment through addressing learning needs more individually (Dolan et al., 2005; Edyburn, 2006; Hitchcock, et al., 2006; Jackson et al., 2009; Pellegrino & Quellmalz, 2010). Studies have suggested, for example, that students with learning differences may perform better with access to assistive technologies (Dolan et al., 2005; Dolan & Hall, 2007; Edyburn 2011; Pisha & Coyne, 2001; Johnstone, 2003; Thurlow, 2010). Dolan et al. (2005) conducted a study by administering two equivalent forms of a test to students with learning disabilities on different days, one a the traditional pen and paper format and the second as a digital format with text to speech. Researchers ensured that students had adequate skills to use the digital format. After completing the test, students participated in a short survey to find out their impressions and then a small sample of students was interviewed (p. 9 & 10). The results gathered from this study illustrated that "students performed slightly better on the [digital with text to speech] version than on the [pen and paper] version" (p.16). Dolan et al. (2005) indicated that students generally showed a preference for the digital with text to speech version than the traditional version. Dolan, Hall, Banerjee, Chun and Strangman (2005) were interested in examining "how universal design might apply to the delivery of assessment" (p. 23) and concluded "assessment techniques that provide students with the best opportunity to demonstrate their knowledge and skills" (p.25) may be helpful given the diversity of those students' learning needs.

Marino (2009) conducted a quantitative study to determine if students with reading disabilities benefits from using technology tools to enhance learning. Marino (2009) showed that there was a positive correlation between students using technology and achievement on tests but "with the caveat that teachers should monitor student tool use" (p.99) since some students do not understand when the tools may help them. Marino (2009) concluded that students many need direction for appropriate use of technology by providing constant feedback. The study of 1153 participants in from four schools in grade six through eights showed that students with reading disabilities benefited more than students with proficient reading (Marino, 2009).

Messinger-Willman and Marino (2010) assert that because of the inherent flexibility with digital text, its use creates opportunities for many students who may have a variety of learning challenges. Digital text provides flexibility for enlarging text, changing font colours, providing text to speech, and sometimes changing the complexity of the text. Within the context of UDL, technology has afforded access for diverse student needs and increased the independence with which students can approach learning tasks as they choose the technology that matches their needs.

Not all students' needs are addressed through diagnosis of learning disability since "regular" students can also experience difficulty with the traditional presentation of curriculum (Meo, 2008). It would be anticipated that UDL principles could improve the performance for students who may experience difficulty but cannot receive supports under the present guidelines for qualifying for access to accommodations. CAST has been instrumental in providing professional development opportunities called Planning for all Learners (PAL) which helps teachers build capacity in meeting the needs of all learners (ibid, 2008). Meo (2008) posits that as

teachers build understanding of UDL through PAL and begin to incorporate universal design into their practice, it positively impacts student learning.

Motivation for the Research

> *UDL assessment requires a clear understanding of the learning goal. With that understanding, teachers can provide scaffolds during an evaluation to help students overcome media-related barriers and show what they really know.*
>
> *~Hitchcock, Meyer, Rose & Jackson, (2005), p.61*

Iterative educational reform is important to keep educational practices relevant and current using the increased knowledge available through research. New research coming from the fields of cognitive science and educational technology can provide solid evidence for increasing technology use to better meet the diverse learning needs in educational settings (Almond et al., 2010; Jackson & Harper, 2006; Meyer & Rose, 2005; Sawyer, 2006; Thurlow et al., 2008; Rose & Meyer, 2002). It is time to put conventional assessment practices under the microscope to determine which approaches are still relevant and which need to be improved. Historical practices have a stronghold in education, even though society is moving from an industrial economy to a knowledge economy (Friesen, 2009; Hitchcock et al., 2006; Sawyer, 2006; Van Duzer, 2006). Technological advancements and the benefits these may offer to all learners can no longer be ignored.

While researching assistive technology, I discovered more about UDL (Rose, 2000), which offered promise in not just recognizing that learners have a variance of abilities, preferences, and passions, but principles on how to address this diversity. Fused with technology, assistive technology and continued research, UDL may help *all* students achieve their potential (Rose & Meyer, 2002).

Through the iterative process of building an appropriate proposal, careful consideration was given to the questions as outlined by Denzin (2005) and particular,

"What difference will it make? How will we know it is worthwhile? Who will benefit?" (p. 945). Given the research available about UDL and the direction toward more personalization of learning, this study may make a difference as it contributes to understanding students' experience with having alternatives to the printed format of material during large-scale assessment.

Awareness created through reflexivity is a salient factor in situating oneself. "Reflexivity represents a methodical process of learning about self as a researcher, which, in turn, illuminates deeper, richer meanings about personal, theoretical, ethical and epistemological aspects of the research question," (Kleinsasser, 2000, p. 155). Reflecting upon my work in special education has built my awareness that the narrow parameters for identification of specific disabilities does not always capture students who have learning needs that are not addressed. The broad categories for disabilities do not fit the particular needs for many of those students creating a plethora of misconceptions about learner expectations. Some students, particularly teenagers who fit the present criteria for accessing accommodations, refuse supports simply because they do not want to feel singled out. I have had conversations with frustrated students who would benefit from assistive technology or other learning supports but do not fit the present protocol for disability in order to access it. Other students may be expected to use supports in all situations when they may only need it in particular situations and may subsequently be refused the support when it is critical. Rose and Meyer (2002) posit that as UDL becomes a part of learning environments, it can change the perception of assistive technology, learner capacity and goals of curriculum. It is not about creating advantages but about creating possibilities since "UDL has the potential to minimize the need for assistive technology and maximize learning opportunities for all" (Rose & Meyer, 2002, p. 81).

Research Approach

This study is guided by a constructivist approach to learning in that knowledge is understood to be constructed through human interaction (Crotty, 1998). Students are able to better engage in constructing knowledge through their lived realities of accessing multiple representation of the grade nine provincial achievement test in order to choose the best mode or modes for their individual learning needs or preferences. Through interpreting students' insights, a better understanding can be derived about how using multiple representation may create a more satisfactory experience in writing exams and specifically the provincial achievement tests. It will provide an opportunity for the student voice to be heard. This research may contribute to changing current perceptions of accommodations for large-scale assessment as those involved with constructing the exam come to understand that elements of universal design have a legitimate and important place in assessment. As stated in *Making a Difference* (Alberta Education, 2010a), "sometimes very minor supports are all that is necessary to allow a student to be successful" (p.60).

From a conceptual perspective, the researcher is interested in both the broad and particular aspects of how educational policies are conceived and implemented and also how these decisions impact students. At the ministry and school jurisdiction level, carefully collected, quantitative data sets from a large sample of the population are considered more convincing when setting policy and making decisions that affect all learners. At the classroom level, educators want to better understand how diverse students learn and experience the examination process, and to use this information to advocate for all students including those who are at risk and those not specifically identified by the present special education descriptors. Students do not always fit the criteria set out by the parameters for special education and each learning environment

has a range of student strengths depending on the tasks and expectations. This research targets new understandings that emerge from the classroom level and students' experiences with test taking and teachers' perspectives on same to both influence practices and to inform better policy.

Although Alberta Education (2011b) recognizes students who are identified as having specific educational needs requiring accommodations for large-scale assessments, this does not necessarily meet the continuum of learner diversity, which may end up marginalizing some students. Assistive technology is seen as an extra support available only for those with identified needs, which restricts use for those who are unidentified but who still may benefit from it (Ketterlin-Geller, 2005; Rose, 2000). This type of accommodation should cease to be exceptional and become universally accessible (Edyburn, 2006; Dolan et al., 2005; Johnstone, 2003; Rose, 2000). This would be providing the alternative options without judging who gets to take which "by providing students multiple, flexible opportunities for recognizing information" (Dolan et al., 2005). Providing multiple representation to all learners means that some students do not to be singled out as requiring extra support. All students can learn when the learning environment does not exclude them by ignoring their needs or highlighting their needs so that they feel aberrant.

UDL reduces the need for ad hoc accommodations by designing access at the beginning stages of planning and implementation benefitting all students (Rose & Meyer, 2002). We need to "incorporate conditions designed to make tests appropriate for the full range of the student populations through enhancing accessibility" (Almond et al., 2010, p. 6). The advances made in technology permit easier access for students to choose different supports based upon their learning needs and preferences; we have

reached a stage in education where we have to defend "why not?" rather than "why provide?" educational technologies in support of all students' diverse learning needs.

The review of the literature for this study expands upon the idea that the growth of technology creates incredible opportunity for everyone including learners in an educational setting. The three principles of UDL, multiple means of representation, multiple means of demonstration and multiple means of engagement, can alter the traditional view of having all students respond in the exact same manner to learning curriculum (Rose & Meyer, 2002). Coupled with assistive technology, UDL holds promise for assessments as well (Chudowsky & Pelligrino, 2003; Dolan et al., 2005; Ketterlin-Geller, 2005; Thurlow, 2010). Although not the same, UDL and assistive technology together can provide support to help students reach potential by dismantling barriers to learning in classroom activities and also in assessments. The multiple means of representation through different access points such as digital audio, text to speech reduces barriers inherent in the traditional heavy text approach associated with large-scale assessments. The literature review revealed that UDL is built on a foundation of influences including brain research, Vygotsky's zone of proximal development and constructivism, Gardiner's theory of multiple intelligences, Tomlinson's differentiated learning and research on educational technology.

The next chapter looks specifically at the research design for building knowledge about the impact of utilizing multiple representation on the grade nine mathematics and social studies provincial achievement tests. The research design targets a deeper understanding of student satisfaction and student experience during exams. The premise of this research is to create an exam environment that provides

better opportunities for all students by enhancing the exam experience through universal access to an audio and written versions of the exams as a starting point of alternatives to the traditional pen and paper test.

Chapter Three

RESEARCH DESIGN

The primary reason for this case study is to explore how students perceive their experience and level of satisfaction with having access to multiple representation on large-scale assessments in the form of the grade nine provincial achievement tests for social studies and mathematics. This study is based on a small sample of students and teachers providing a useful perspective even though it cannot be generalized to the whole population of grade nine students and teachers across the province. Still it can be reasoned that this case study may spur further exploration to build results from a broader base of students.

It was critical to keep revisiting the data throughout the analysis and writing process to figure out how the notes compared across the quantitative and the qualitative data. The iteration of reviewing the data, albeit time consuming, enabled the researcher to purposefully meld the notes, transcriptions, reflections together to emergent themes. Once the themes were established, several more passes were made to ensure that the triangulation made sense from the data that was gathered.

Stake (1995) posits that it is important in case study to gather multiple perspectives, not for the purpose of generalizing, but to gain a more thorough and deep understanding of the phenomena of interest. The case study is the study of a real life phenomenon "to engage the best of our interpretive powers, and to make, even by its integrity alone, an advocacy for those things we cherish" (Stake, 1995, p. 136). This particular case study happens within a natural setting at school. The new knowledge about the phenomena is created through triangulating data sources including observations, pre and post student surveys, student interviews and teacher interviews (Stake, 2005; Yin, 2009). It was anticipated that by permitting all students

to have access to an audio version as well as a written version of the grade nine exam this action would create an examination environment more conducive to meeting the diverse learning needs present in any group of students in a formal educational setting than the present practice of providing audio only to students with an identified disability. "Discovering and portraying the multiple views" is integral to building the understanding in a case study (Stake, 1995, p. 64). It was not enough to ask students about their experience; the researcher sought the teachers' perspectives and relied on first hand observations of the examination context and exam writing experience.

Stake (1995) suggests that case study is about analyzing the data to understand the case either through "categorical aggregation or direct interpretation" (p. 77). Sometimes drawing a simple conclusion of the meaning can be helpful while other times it requires a deeper contemplation of the data through reflection and triangulation (Stake, 1995). Yin (2009) espouses that case study "allows investigators to retain the holistic and meaningful characteristics of real-life events" such as lived experienced in test taking or other school performances (p.4).

In this research, the focus is on "how" having access to multiple representation impacts learners while taking into account the survey of a slightly larger student population to see how many learners are interested in access and how many think it may make a difference. Stake (1995) asserts that discipline and protocol work together with common sense of a researcher who seeks to "get it right", meaning the description of the research would be meaningful to the participants and those interested in the impact of multiple representation on large-scale assessment including policy makers. The "data analysis spiral" demonstrated by Creswell (2007, p. 151) helped to conceptualize the direction for working with the data in the present research. The data analysis spiral is not linear but does move from data collection to

analysis to being able to effectively report on case study findings after analysis. The coding of the data contributes to the development of themes for writing (Creswell, 2007). It is important in the analysis to consider all perspectives to defend the findings (Yin, 2003). Yin outlines four general strategies for analyzing case study evidence. These strategies rely on theoretical proposition, case description, using both qualitative and quantitative data and examining rival explanations (Yin, 2009, p. 130-133). The first strategy of relying on theoretical propositions means that the proposition defines the data collection plan and "helps to focus attention on certain data" (Yin, 2009, p. 130). The second strategy is to develop a case description by building a framework, which will provide the backbone for organizing the case study. According to Yin (2009) this best functions as an alterative when the analysis of data is convoluted. The third strategy described by Yin is to use quantitative data as a part of the study with the qualitative data being the key element to the case study. The quantitative data helps back the outcomes that the case study is explaining or the data is embedded as one unit of analysis within the case study (Yin, 2009). The fourth strategy can be used with the other strategies through the examination of rival explanations which can strengthen the research by exploring what other perspectives or biases may be influencing the data (Yin, 2009).

Of the four strategies, I draw upon the two strategies, specifically the third strategy to combine qualitative and quantitative data and the fourth strategy to consider rival explanations. The qualitative data helps to provide insight into students' perceptions and detailed thoughts about having access to the technology and the quantitative data helps to provide insight into a broader range of students views about utilizing technology and how many of the participants used the technology, for how much of the exam and whether they would use it again. The combination of

qualitative and quantitative data sources provides more insight than either one might offer alone. Yin (2003) states that high quality analysis are guided by four principles: paying attention to all the evidence; considering alternative reasons; figuring out the most important aspect of the case, and; using expert knowledge gained (p.137). The fourth strategy of considering rival explanations provides insight into aspects of the research data through figuring out possibilities of why students chose to use or not use the audio supports. What would we need to address to make the experience different?

In determining the best way to design this case study, a mixed method approach to data collection and analysis appeared to make the most sense in that it would allow for the triangulation of several forms of data and thus strengthen the knowledge claims based on the study. The approach has the advantage of gaining insights from both the qualitative data, from the interviews with students and teachers and from the quantitative data, from surveys, which offers a more global perspective on the phenomena of interest (Creswell, 2009; Johnson, Onwuegbuzie & Turner, 2007). Using a "sequential" process, a pre- and post- survey was conducted first, followed by individual one-on-one interviews with study participants, which enabled the researcher to gain deeper insight into learner and teacher experiences (Creswell, 2009). The data collection and analysis considers the human factors about students' lived experience while participating in the study and teachers' expert and experienced insights about the exam context and student experience with writing the exam. The data collected and built insights about the views of the participants as they went through the experience (Creswell, 2009).

Finally, when considering research design, one must consider four elements: epistemology, theoretical perspective, methodology and methods (Crotty, 1998). This conceptual framework can help one make logical decisions about what data to collect

and then trustworthy conclusions based upon the analysis of that data. In this study, the epistemology is constructivist. The intent is to seek greater understanding about the teacher and student experience of having accessing to the audio version of the exam along with the written format, what difference did it make, and what were the challenges. This understanding would contribute to figuring out whether more research on a broader scale may be important to pursue.

Using mixed methods seemed appropriate since it is "an approach to knowledge (theory and practice) that attempts to consider multiple perspectives, positions and standpoints (always including the standpoints of qualitative and quantitative research)" (Johnson et al., 2007, p. 113). It was important to recognize that having access to multiple representation for all students on a large-scale assessment regardless of academic achievement, motivation, learning needs or disability has not been an option available for provincial achievement tests in the past. Therefore, it was deemed important to study teachers and students perceptions of having access to multiple representation via assistive technology during the exam, and to collect data that could yield insights into their experience. Triangulating data from surveys, interviews and field notes permitted a deeper understanding of the phenomenon.

Researcher Profile

> *If we can no longer use detachment, distance and neutrality to achieve objectivity, we can at least document and track how what we study is influenced by who we are.*
>
> *~Preissle, 2006, p. 691*

Research may be influenced by the many different ways of viewing the world and the experiences that the researcher brings. As a special educator with more than twenty years of experience, mentoring diverse students [and working with diverse

colleagues], I have met and worked with many students who present with an array of learning needs. From working with these students, I understand that students do not all learn in the same way; some students require more resources through the use of assistive technologies, differentiation and accommodations than others. As I advocated for accommodations and promoted the use of assistive technology in my own schools, I observed the positive impact assistive technology had on student outlook and achievement but some of the limitations as well. I have promoted the use of assistive technologies to support a myriad of student disabilities and wondered how technology, and in particular assistive technology, could reduce barriers for all students during test taking while also decreasing the need for specific accommodations for some students. I have also advocated for students as they tackled the rigours of academic work in environments that only cater to the elusive "average" student. I am particularly interested in UDL because it offers the potential to provide greater access to learning for *all* learners (CAST, 2012a) while creating a neutral environment where the learning supports inherent in UDL may not be that visible since the supports do not singling out specific students as requiring more than any other student.

Establishing a Site

Preliminary work

At the beginning stages of the proposal development, permission to conduct the research was sought and gained from a principal of an urban public high school to carry out the study with the grade 12 students who would write the Social Studies 30 diploma exams. This plan was revised to conduct the study with students who were writing the Social Studies 30-2 diploma as part of the iterative process after I had a

discussion with the director of assessment with Alberta Education (personal correspondence, August 2011). The discussion with Alberta Education personnel brought forth perspectives points from the ministry that although the study would be important, narrowing it to the Social Studies 30-2 may be more palatable to the assessment team especially since there would be limited time to have the assessment team figure out if the study would cause broader implications for the participants. After members of the Education Ministry reviewed my proposal, they met with me to define constraints that may interfere with moving forward in a timely manner with the research on the grade twelve diploma exams. A number of issues were brought forward at the meeting. The first roadblock would be that the diploma exam would not be available in digital format. I was more interested in providing students with access to alternate format by providing an audio version. However, the Education Ministry indicated that copyright permission to use the audio format was only approved to provide access for students with qualifying disabilities supported by diagnostic information. Although I could work to gain copyright permission for the source material, it would be extremely time consuming and delay the study for an indeterminate amount of time. The sources used on the diploma exam came from multiple authors who would each have to give individual permission for particular questions to be provided in alternative format and this may or may not be forthcoming. Even with the researcher seeking and gaining permission, the ministry was concerned if the time constraints on the diploma would be detrimental to students using a different format of the exam. Students who qualify under special education are permitted extra time but students without a qualifying diagnosis would not have access to extra time and may run out of time while using the multiple representations.

The ministry was concerned that the time restraint may compromise students' performance and therefore jeopardize individual student results.

Another idea presented by the ministry was the possibility of a similar study but utilizing the grade nine provincial achievement tests. The ministry had broader copyright permissions for using alternative format because of the work with the digital formats planned for use with a number of schools. Along with my doctoral supervisory committee, I considered this idea and concluded that the provincial achievement tests at the grade nine level afforded an opportunity to use a wider population of students since it would be presented to all students in grade nine, and not simply those who were registered in a particular level in high school. The doctoral supervisory committee also suggested that the interviews conducted with grade nine students may provide deep insights about students' perceptions. In order to conduct the research in a timely manner the plan was to utilize the January 2012 examination time to conduct the study. Revising the research plan in the context of these constraints helped to provide an avenue for timely research that aligned with the original purpose of the proposal.

Feasible site

Although significant preliminary work had been completed to establish a site for research with a grade twelve group utilizing diploma exams and the site was ready to move forward with the research, it became clear that barriers to the research (i.e., diploma exams, politics, time, access, copyright, etc.) would not be solved in a timely manner. So, with reorganization, a goal was established to find a feasible grade nine site to conduct the pilot. From knowledge gained at meetings with the ministry and the doctoral supervisory committee, I was aware that several boards across the province had grade nine programs that were split into semesters and would therefore

have provincial achievement testing in January. Several districts were contacted to find a viable site. To move the study forward in tighter timelines meant it was important to find sites with January provincial achievement testing. With permission at the district level of a rural public school board, principals of two rural schools were contacted. After these principals consulted with their respective staffs, the teachers readily volunteered to be a part of the study because they wanted their students to have the opportunity to participate in having universal access to multiple representation on the provincial achievement tests.

Research Participants

The research participants were drawn from two rural Alberta public schools. All grade nine students writing mathematics and/or social studies registered in the first semester from the two schools in the study were given the opportunity to participate for the January exam period. It was not a requirement for all 105 students to participate in the research; however, all students were given the choice of access to multiple representation regardless of their decision to utilize the support or to participate in the survey or interview. It was anticipated that the size of the student population who would choose to participate in the study would provide enough information that would allow rich analysis for coding of data for the study. Students were all part of a general education classroom and not selected based upon learning needs or school marks. Both schools serve students in grade nine to grade twelve. The size of the participant group allowed for both quantitative and qualitative interpretation of the data as a small sample of a regular rural school within Alberta.

Methodology

Introduction of research

Once the teaching staff consented to the research, students and parents were informed of the research. Each principal decided how much access the researcher had in the school. At one school, the researcher met with teachers and was introduced to the students. The researcher gave a short ten-minute introduction about the research opportunity, thanked them for considering the research while telling them that they were under no obligation to participate and then gave students the research package to take home. At the other school, the principal introduced the research opportunity to staff and students. Teachers gave the research packages out to the students and students returned them to a drop box in the school office.

The research information packages used at both school sites described the research, informed parents of the implications of the research, any associated risks, and asked for informed consent with the acknowledgement that students could opt out of the research at any time. There were separate consent forms for the teachers, students and parents. Parents needed to consent for the students to participate and then the students had to give their assent to participate on a separate consent form as instructed by the ethics board overseeing the research. Parents could consent and then students could choose not to participate if they did not sign their consent forms. Teachers signed consent forms to participate in the research. All students including those participating in the research were given access to an audio version for an assessment leading up to the grade nine provincial achievement tests in order to practice the process. All participants including parents who gave consent were invited to call or email the researcher or the graduate supervisor if there were any questions or concerns about the research carried out in the school.

Practice Tests

The grade nine social studies and mathematics tests were provided by Alberta Education, Assessment Branch, with an audio version as well as written version. Prior to the provincial achievement test, all students were given the opportunity to use an audio version of tests in at least one classroom assessment such as unit exam or quiz to ensure familiarity with the process prior to using it on the provincial achievement testing. Teachers at both schools provided the researcher with copies of classroom tests for mathematics and social studies. The researcher converted the written tests into digital audio files to provide students with real tests from their class for the practice scenarios. These digital audio files were returned to the teachers and they provided opportunities for the students to participate in the test writing practices using the audio form along with written form during class time. Students were free to choose whether they wanted to try the audio files in a testing situation or not. Students listened to as well as read the questions on the tests.

Study Instruments

The study used researcher observation, student interviews, pre and post surveys and teacher interviews for data analysis.

The pre and post surveys were designed by the researcher to gather a broader perspective from a larger number of participants than interviews to explore ideas about student perceptions of utilizing technology during large-scale assessment. The results of the pre and post survey were used to compare how students' perceptions appeared to stay the same or changed, to identify concerns that may be addressed in

the interviews, and to gather demographic information. The pre survey had twelve questions and the post survey had eighteen questions

Survey items were designed to gather information about student demographics, academics and technology use such as how many students do not have an IPP, the distribution of school marks and how much time students spend using technology. These surveys took about five to ten minutes for students to complete. The pre and post surveys also considered student perspectives about preconceived notions and then how their perspectives may or may not have changed throughout the experience. These surveys afford analysis of their lived experience of having access to the multiple representation through the use of technology. Unlike the interview, which was more open-ended, the survey "entails more structured questions" with selected responses (Yin, 2003, p. 91).

Open-ended one-on-one interviews were conducted with two types of participants, one with students and one with teachers. Questions were pre-established but the interview context was meant to be more informal in order to generate more information from the survey to illustrate more specifically some of the lived experiences of the staff and students through their discussion of ideas. Questions considered staff and student opinion about utilizing technology during the school day as well as in exam settings, advice or ideas for change, and experience with utilizing multiple representation on the provincial achievement tests.

These interviews are a critical source of data and should be "guided conversations rather than structured queries" (Yin, 2003, p. 89). Participants need to feel valued for their perspectives and contributions to the study by allowing the interview to take a natural direction even if it moved away from the tentative question outline (Denzin, 2005; Marshall & Rossman, 2006). Personal interaction and good

listening skills are important to the interview process since it encourages students and teachers to feel more comfortable about sharing their authentic viewpoints (Ezzy, 2010; Stake, 1995). Stake (1995) posits that the questions should create general flow for the conversation to capture the main substance of the research questions. These interviews were used to gather greater details about the experiences of the participants that cannot be gathered in other formats, which will afford deeper understanding of the process (Yin, 2003). It was imperative to complete an immediate synopsis after the interview to capture the exact meaning of the interviewee (Stake, 1995).

All interviews were conducted over the phone and recorded to ensure accuracy of ideas that are communicated; recordings also helped with coding themes for the analysis. Recording the interviews helps to "preserve the complexity and detail" that interview notes could not achieve (Idler, Hudson & Leventhal, 2008, p. 406). Students and teachers were informed of the recording and asked again before the interview started for a second verbal permission to record. The first permission was through the consent forms. The participants were guaranteed anonymity and all participants understood that, other than the graduate supervisor, the researcher was the only person who would be accessing the raw data for coding (Creswell 2007). Student interviews required about thirty to forty minutes of their time while teacher interviews required about forty minutes to an hour. All interviews were arranged at the participants' convenience. A total of eleven students and five teachers participated in the one on one interviews.

Students were surveyed at the beginning of the research to establish preconceived views about the use of audio and then at the end, after the testing situation, to determine changes in perception. The post survey was also used to gain insight about students' experiences, if they considered access to multiple

representation worthwhile and how it impacted their exam experience. All students who consented to the research were invited and encouraged to participate in the online surveys. Students were randomly selected to participate in a one on one interview using open-ended questions. All teachers were also invited to be interviewed about their perceptions of utilizing audio with written format.

Provincial Achievement Test Options for Pilot

Typically, students receive only one format for the provincial achievement tests, which is the written paper format. All students, regardless of reading ability take this one-size-fits-all format. The digital format is slowly becoming another way that students can access the test if their school have applied to utilize Quest A+, a web-based digital test application used by the ministry.

For the study, the ministry gave permission for each student to have access to all three formats provided by Alberta Education: the written format, a digital format through Quest A+ and an audio CD. Typically the audio version is only available for those students who qualify through an IPP. There is a growing population of schools accessing Quest A+ and unlike the audio version, it is not limited to certain students who meet diagnostic criteria. Although technology is slowly being integrated into provincial large-scale assessments, the exams are using the same structure as the pen and paper copy. While the delivery of the exam has changed to electronic versions in some instances, much of the format has remained the same, where the emphasis requires students to read and comprehend a question, and then indicate their chosen response from a set of options. Current paper and pencil test formats on Alberta provincial achievement test do not yet incorporate any multimedia that may lend itself to UDL. "New technology-enabled assessments, supported by research on how

students learn, experts argued, would allow us to present complex, multi-step problems and record descriptive data about strategies used and actions taken by students" (Tucker, 2009, p.2).

Both schools declined the use of Quest A+ because it would require that the students would need two computers each. The Quest A+ would lock out the use of the access to the audio through the CD, the only method for audio transmission since the Quest A+ does not yet have full capacity for text to speech. In order to have the audio, a choice was made to go with the written paper format and the audio. Using a digital copy on a computer, along with the audio CD on another computer would be an unrealistic expectation based on the resources available at schools. The computers were utilized to access the audio CD. All students in the study were given the opportunity for access to an audio version as well as the written format.

Ethics Approval

> *Consistent with its commitment to individual autonomy, social science in the Mill and Weber traditions insists that research subjects have the right be informed about the nature and consequences of experiments in which they are involved.*
>
> *~ Christian, 2005, p. 144*

A critical piece of pursuing research is to meet the obligations outlined in an appropriate ethics application. Ethics approval was obtained from the University of Calgary Conjoint Faculties Research Ethics Board (CFREB). This ethics approval also satisfied the school board requirements for conducting research within the district. Each participant signed off on informed consent as part of the process to participate in the research with the understanding that it did not lock any participant into continuing the research once initial permission was given.

Data Collection and Organization

All survey and interview data were kept in two binders and one digital file. One binder contained information required to begin conducting the research including the research package given to each parent including the letter of introduction to parents and consent forms along with all information received back including contact information, research consent form for students and research consent form for parents and teachers. The other binder contained all of the raw data including copies of the transcribed teacher and student interviews, an aggregated summary of the teacher interviews, an aggregated summary of student interviews, a copy of the results of the pre and post surveys and a copy of the both sets of interview questions. The digital file contained copies of the ethics approval, copies of email communication with both schools, copies of email communication with my supervisor, digital recordings of interviews and transcribed interviews. All data will be used only for this research study, and will be securely stored until determined by the researcher and supervisor, in compliance with the ethical approval parameters, that it can be destroyed.

Data Analysis

> *The quantitative side of me looked for the emergence of meaning from the repetition of phenomena. The qualitative side of me looked for the emergence of meaning in a single instance.*
>
> *~Stake, 1995, p. 76*

Once the data were collected the next step was to analyse the survey and interview responses to build meaning and to answer the research question for the study. Analysis is a multi-step process beginning with "tidying" the data so that the analysis can have a coordinated process (Creswell, 2007; Preissle, 2000). This tidying includes organizing the data, creating tables, reviewing research questions and identifying holes allowing the researcher to "make a preliminary assessment of the data set" (Preissle, 2000, p. 148). During the analysis of data for qualitative research,

it is important first to organize the data to make interpretation possible and then "use it to construct an intact portrait of the original phenomenon under study and second, to tell readers what that portrait means" (LeCompte, 2000, p. 147).

After this is completed, the researcher can begin the process of the coding the data through continuous review of the surveys, interviews and field notes. The coding allows for comparing and contrasting data to build themes and formally represent the interpretation (Creswell, 2007; Marshall & Rossman, 2006). Once the themes are established through the evidence provided in the data, the study can be presented. Finally a discussion of the results provides knowledge obtained from the research as well as direction for further study.

This third chapter has described and provided details on how this case study research was designed and carried out, and how the data was collected and to be analyzed in order to gain a more valid and reliable understanding of how multiple representation provided an opportunity to dismantle barriers to typical large-scale assessment. The focus was on the grade nine classes in two small rural schools and analyzing the perceptions of the students and educators who participated in the study. As an exploratory case study it is not meant to produce generalizations for the whole population of grade nine students in the province but to provide an opportunity for building further knowledge about universal design and assessment. It contributes to the limited research in the field.

The next chapter explores and analyzes the data on student and teacher experiences while the innovation was used and this research occurred at their schools. The data from all sources is analyzed and interpreted to provide insight and new knowledge to address the research question.

Chapter Four

ANALYSIS

> *The process of bringing order, structure, and interpretation to a mass of collected data is messy, ambiguous, time-consuming, creative and fascinating.*
>
> *~ Marshall & Rossman (2006, p. 154)*

The purpose of the chapter is to analyse the data regarding the students' perceptions and experiences of accessing audio for their provincial achievement testing. The case study was designed to explore student experiences with access to audio version of the test combined with the written format during grade nine provincial achievement testing in mathematics and social studies. "The arbiters of research quality will be the research stakeholders, which means that the quality or validity issue can have subjective, intersubjective, and objective components and influences" (Onwuegbuzie & Johnson, 2008, p. 274). The data illustrates how student participants and their teachers viewed this experience and results align with the primary purpose of the research which is to determine whether having access to multiple representation through alternatives for printed material provided satisfaction with the exam writing process. The interview questions helped to illuminate and gain access to the perceptions of students and teachers. Given that utilizing multiple representation on large-scale assessment may impact the experience of students, it was important to seek feedback from them about their experience. Quotes, descriptions and perspectives from students provide a more nuanced understanding of the exam experience than a simple survey of the experience using select response questions.

The data analysis is in three sections: 1) survey results, 2) interview results, and 3) established themes through interpretation and triangulation of data sources.

Survey Results

Participation Numbers

An educator from the study indicated that a number of students had indicated that they declined because participating in any research went against those students' particular religious beliefs or because they objected to research (personal communication, January 2012).

Some students did not return forms and may have forgotten to give them to parents, while other students simply chose not to participate. All students were given the opportunity to access the technology for use during the exam without being required to take part in the study.

Surveys	Females	Males	Total Number
Pre-Surveys	34	32	66
Post-Surveys	30	18	48

Table 1: Survey Participants by Gender

Complete pre-survey results were obtained from 66 participants of a total grade nine population of 118, which was close to 50% of the population for that grade level at both schools. The pre survey participants were spread across genders with 51% female and 49% male of the total participants (n = 66). Post-survey results were obtained from 48 participants (41%) of the same population, with this sample including 63% female and 37% male students (n = 48).

About 9% of the students participating in both the pre and post surveys indicated that they were on an individual program plan (IPP) and met Alberta Education criteria for a diagnosed learning need (such as a learning, sensory, physical or emotional disability). These students may have "officially" qualified for the audio support during the exam. Instead, for this study, the audio support was universally

available for all students in this particular testing situation. From this information it becomes evident that students who would not normally have qualified for accommodations during the testing situation, such as an audio version, participated in the study.

Use of Technology at Home

When students were surveyed about their use of computer technology at home, many students indicated that they do use the computer for varying amounts of time.

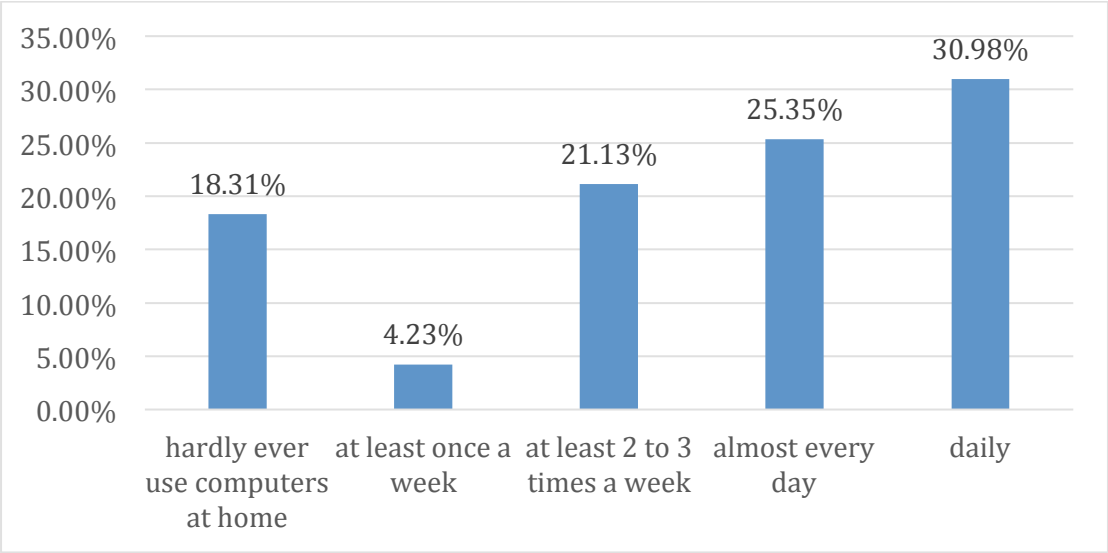

Figure 1 Pre-Survey: How much time do you use computers at home?

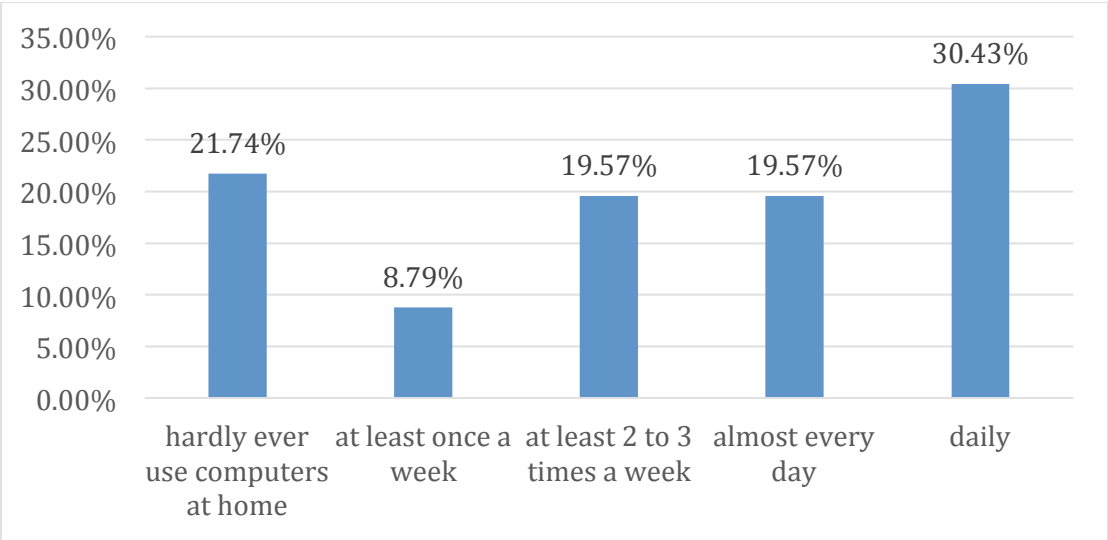

Figure 2 Post-Survey: How much time do you use computers at home?

Both Figure 1 with pre survey results and Figure 2 with post survey results indicated that the majority of students participating in the survey (70% - 78%) used the computer at home at least a couple of times a week to research things with almost a third of those (30% +) reporting that they use the computer daily. About a fifth of the students (~18% in the pre survey and ~22% in the post survey) report they are not using the computer much while they are at home.

Use of Technology at School

The results of the survey suggested that most students use computers at school but for varying amounts of time.

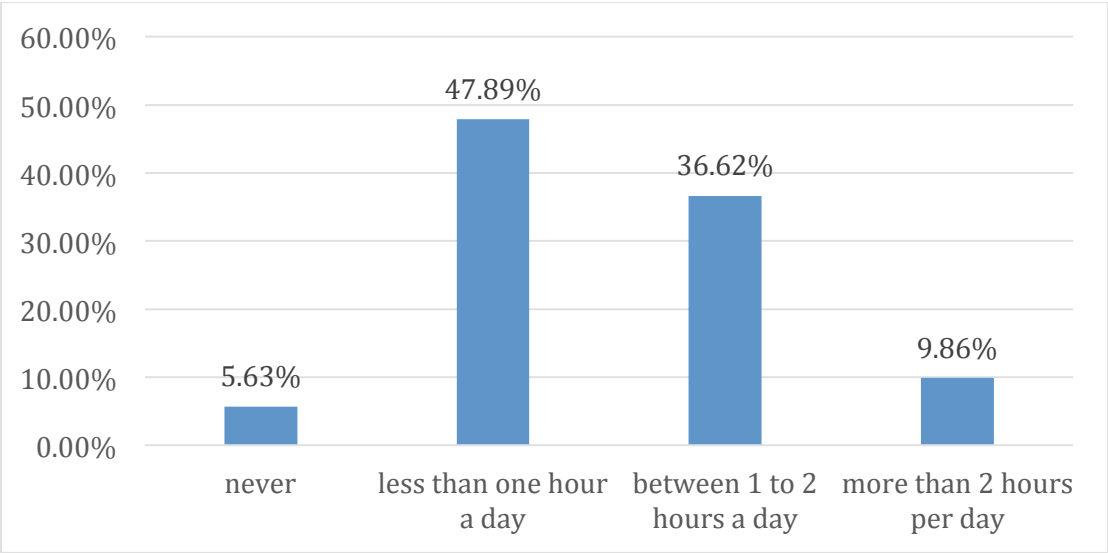

Figure 3 Pre Survey: How much time do you use computers at school?

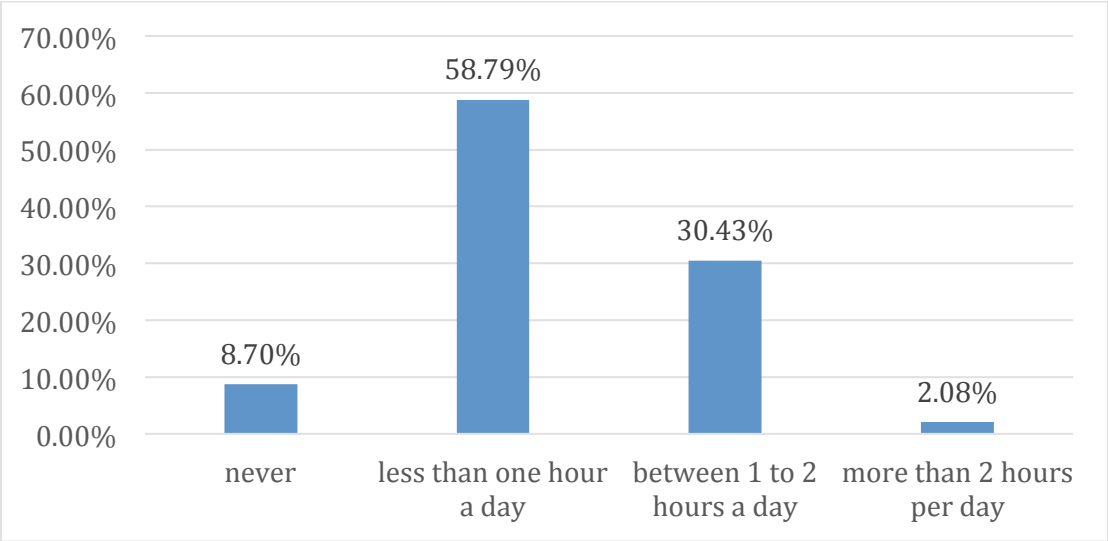

Figure 4 Post Survey: How much time do you use computers at school?

Figure 3 pre survey results and Figure 4 post survey results showed that just over a one half (between 50% to 60%) of students surveyed reported using the computer less than one hour a day at school. The pre survey indicated that less than one tenth of the students (9%) reported using the computer more than two hours a day and the post survey indicated that only a minimal number (2%) reported using the computer for more than two hours a day. In informal conversations, staff indicated

that the technology resources needed to be shared with all classes at the school and therefore pervasive access to technology at school was not possible.

Students were asked how frequently they used technology in testing situations. Figure 5 illustrates the results from the pre survey question, how frequently did you use technology in testing, and shows that only a small number of students (8%) indicated that they used technology weekly in testing situations.

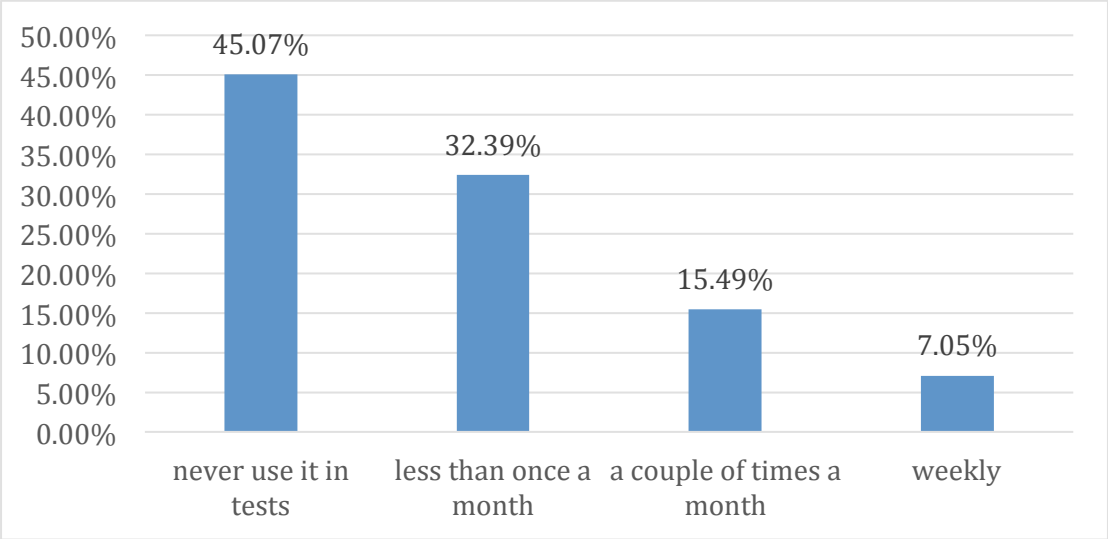

Figure 5 Pre-Survey: How frequently did you use technology in testing?

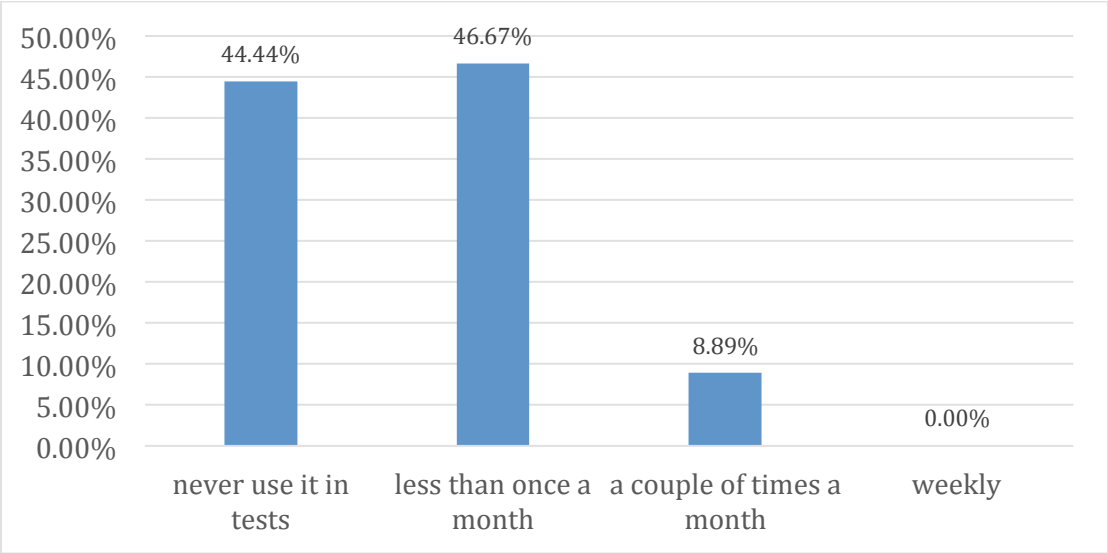

Figure 6 Post-Survey: How frequently did you use technology in testing?

In the post survey shown in Figure 6, which excluded utilizing technology in mathematics and social studies, none of the students utilized technology in testing situations on a weekly basis. Students were asked to only count whether they used technology in testing excluding mathematics and social studies since they had been using technology in those classes in preparation for having access on the provincial achievement testing.

Figure 5 and 6 demonstrate that only a few of the participants (9%) in both the pre and post survey reported using technology a couple of times a month in testing situations. This question and results proved to be unclear since it did not indicate what type of technology students used and what they did with it in testing situations.

Interest in Access to Technology for Testing

Students were asked about their interest in using technology to personalize learning and in particular to provide more satisfaction in testing situations.

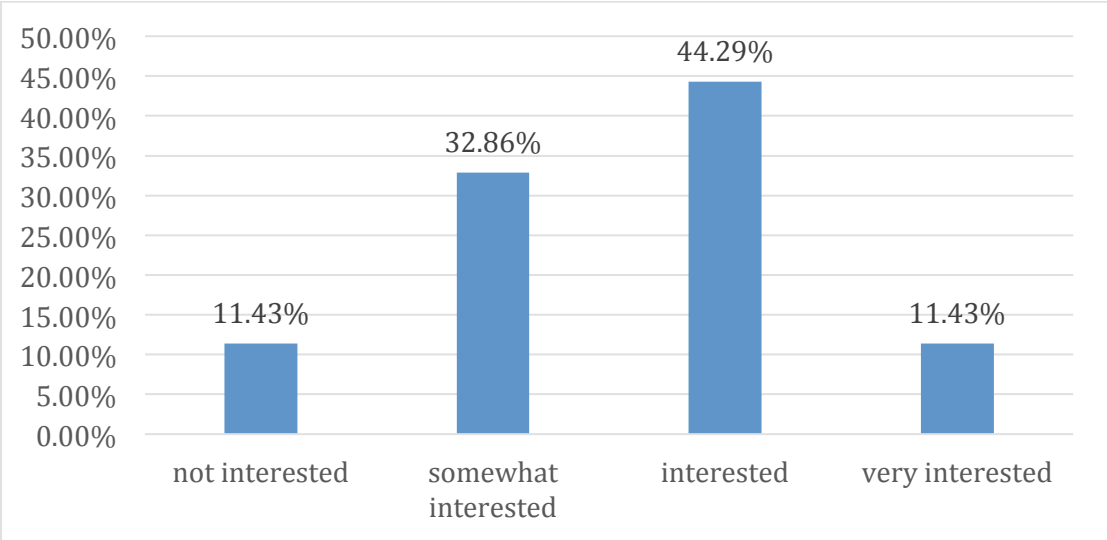

Figure 7 Pre Survey: Interest in using technology for testing

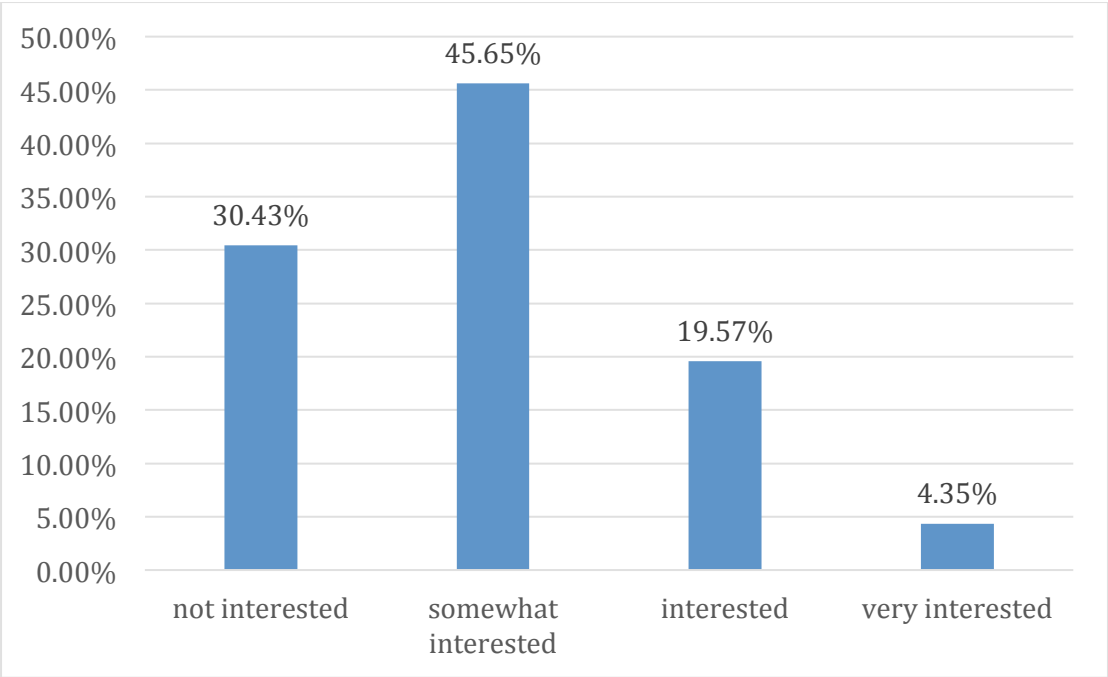

Figure 8 Post Survey: Interest in using technology for testing

Figure 7 illustrates that most of the students (88%) in the pre-survey were somewhat interested to very interested in being able to utilize technology such as text to speech, digital audio or audio CD for exams and tests to suit their personal learning preferences. This is important since the study wanted to determine levels of satisfaction about accessing text to speech, digital audio or audio CD for the exam. Even being somewhat interested supports the choice since students may not want to commit fully but would participate given the opportunity. Figure 8 shows that fewer students (70%) were interested in utilizing technology when asked in the post survey. Interviews helped to clarify the drop from the pre survey to the post survey. Staff and students indicated that the audio format provided by Alberta Education for the provincial achievement testing was less intuitive than the individual digital media player and student computers used during the lead up to the provincial achievement testing and therefore turned out to be more difficult to use.

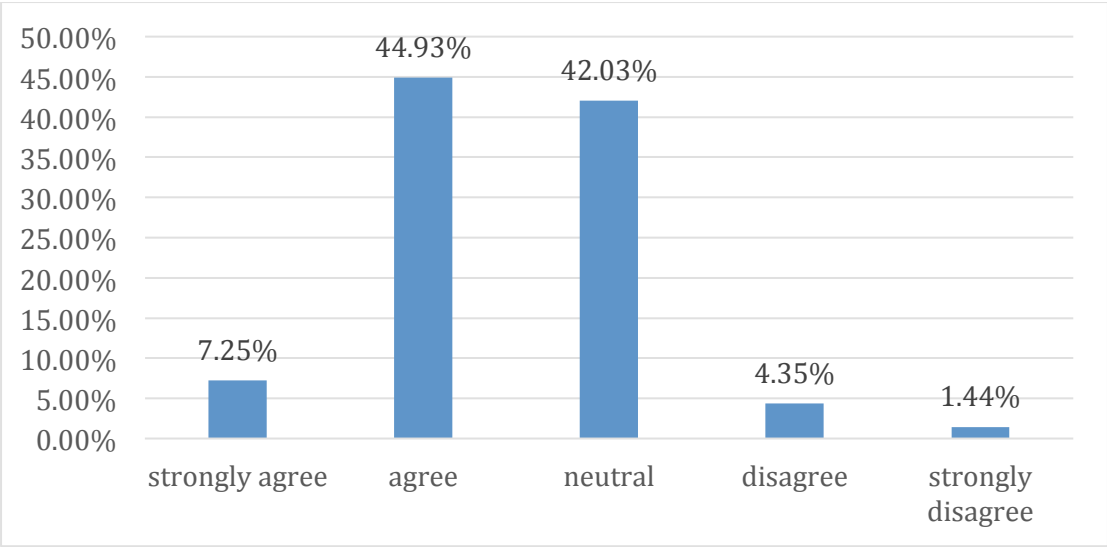

Figure 9 Pre Survey: Using audio support can improve performance

Figure 9 shows that when students were asked in the pre survey if they thought that having access to digital text with text to speech software or audio version with the written would improve their performance on tests, about half of the participants (49%) agreed or strongly agreed that it would improve their performance. A few (6%) either disagreed or strongly disagreed that it would be helpful.

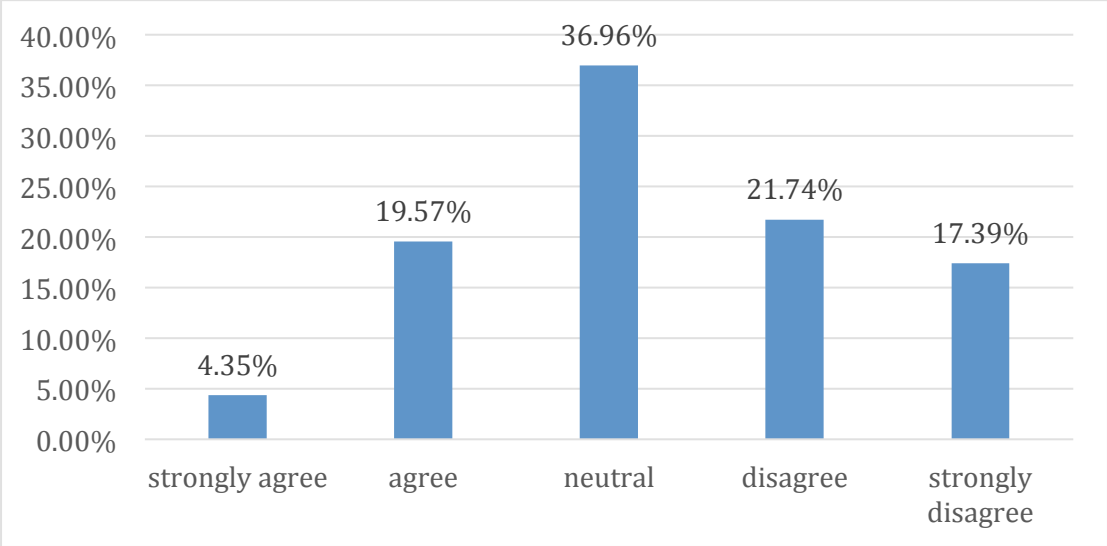

Figure 10 Post Survey: Using audio support can improve performance

Figure 10 illustrates the results of a follow up question on the post-survey asked if students would find having access to digital text with text to speech, digital audio or audio CD more satisfying than traditional pen and paper. Only a few (3%) disagreed or strongly disagreed that it would be more satisfying. Over a half (59%) agreed or strongly agreed that it would be more satisfying. Over a third (38%) were neutral about the level of satisfaction. This is important to note since students who were neutral may want to have access on further exams as they further build their perception about the value to them. The neutral response may be the students' way of not having a positive or negative opinion about access or still being undecided about their response. Sub-questions clarifying what they found satisfying or unsatisfying may have provided more insight and would be used in further studies. Students could access the audio version for a part of a question, a couple of questions or for the whole exam which gave wide parameters for levels of satisfaction with not really needing it for certain parts of the exam while finding it quite useful for other parts of the exam.

Perspectives about Reading Ability

Students were asked about their perception of whether they thought they lost marks on exams because they misread questions or important words in questions. Figure 11 shows results from the pre-survey. Over half of the participants (66%) agreed or strongly agreed that they lose marks on tests because they have misread a question or missed important words in the question. This is important because students may have performed better and possibly had a more satisfactory experience with access to more than one format. Figure 12 shows over one half of the

participants (60%) believe that their marks would be higher on tests and exams if they could read as well as listen to the questions.

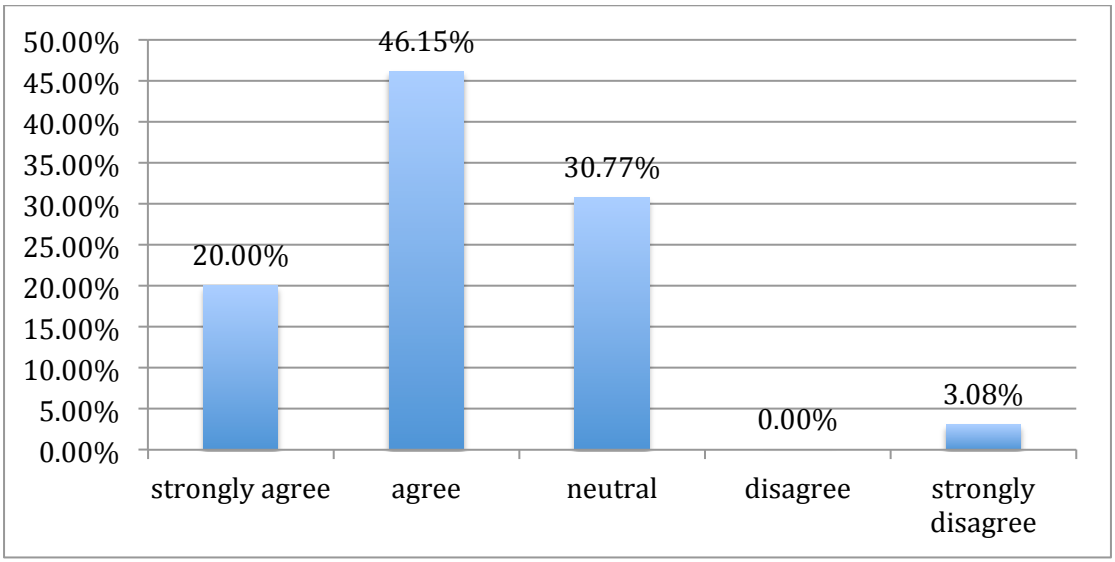

Figure 11: Opinion about losing marks by misreading questions or important words

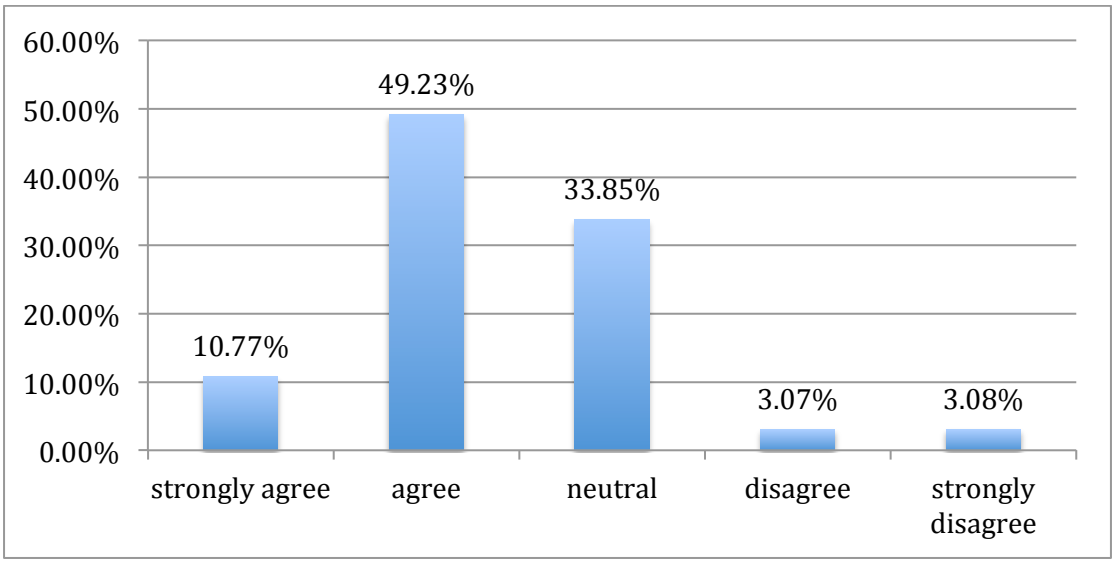

Figure 12 Opinion that reading as well as listening will improve individual test results

When responding to the statement, "I am a strong reader", in the pre-survey results shown in Figure 13, about one half of the students (52%) agreed or strongly agreed with the statement. In the post survey shown in Figure 14, almost two thirds (64%) agreed or strongly agreed with the statement. This result was interesting since

the audio is typically only available for students who have diagnosed learning needs and, in particular, reading disabilities. Some of the students who perceived that they were strong readers opted to use the audio for test taking. Even though most of these students believed they were strong readers the results showed that they also thought that they lost marks from misreading words or questions. More than fifty percent of the students also thought that reading as well as listening would improve their test results.

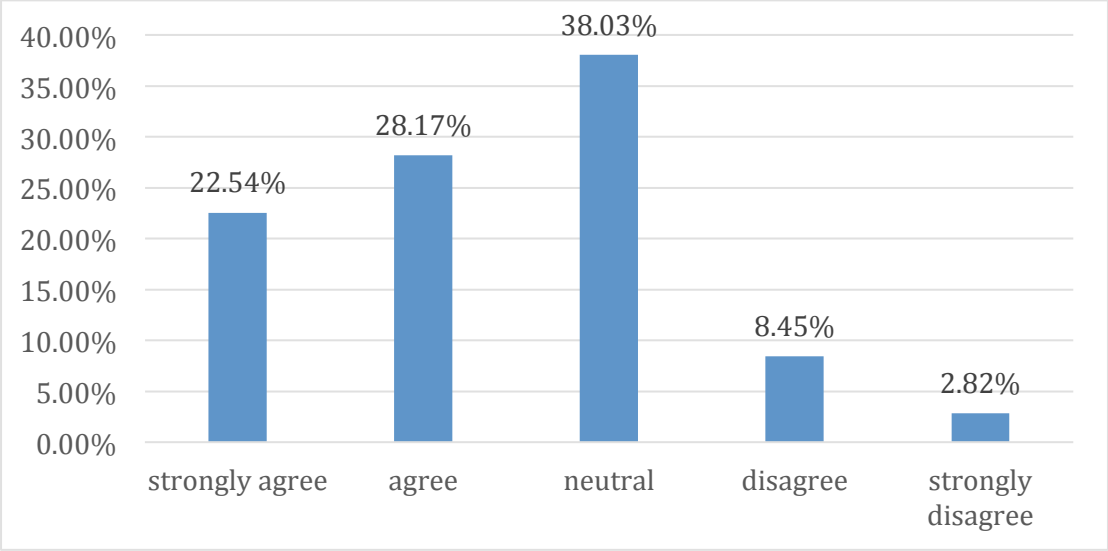

Figure 13 Pre Survey: I am a strong reader

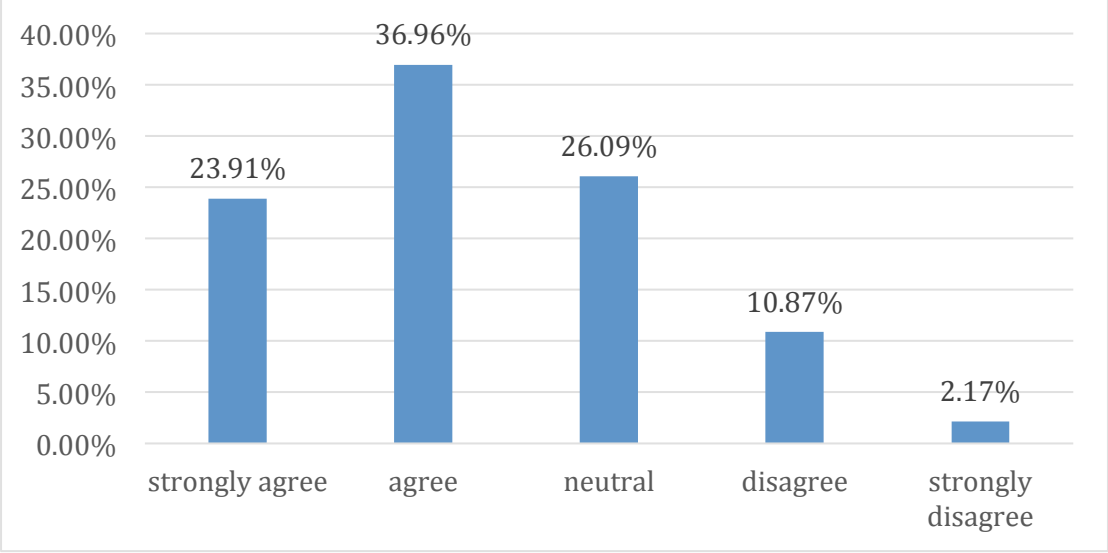

Figure 14 Post Survey: I am a strong reader

Satisfaction with Access to Multiple Representation

Of the students who chose to access the audio along with the written format during the exam, close to a third (30%) found the process of using the technology to be difficult. The question did note that students felt that the technology was difficult to use. While the survey did not provide the specificity at the root of their noted difficulties, it provided an opportunity to further pursue the students' perceptions about the difficulty of the technology.

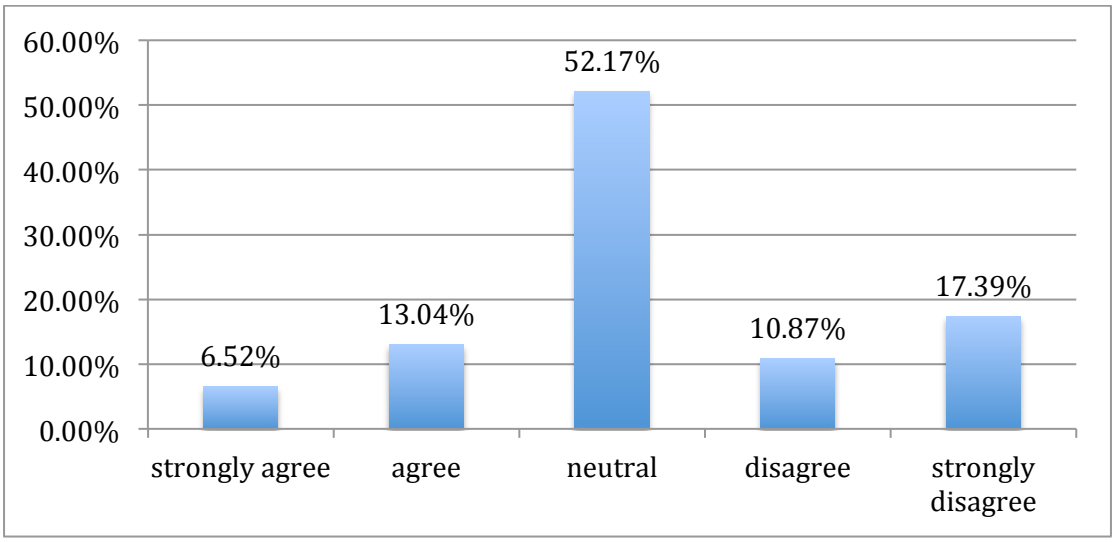

Figure 15 Post Survey: My experience using the technology was positive.

When offering their opinion about the experience using technology was positive, Figure 15 illustrates that almost three quarters of the participants (72%) indicated that their experience was either neutral or positive while just over one quarter (28%) disagreed or strongly disagreed that they had a positive experience. The large percentage of students who responded neutral may be indicative of those who use technology without much thought about whether it was positive or negative. Interviews helped to provide more clarity for this question, which will be reported upon in a subsequent section.

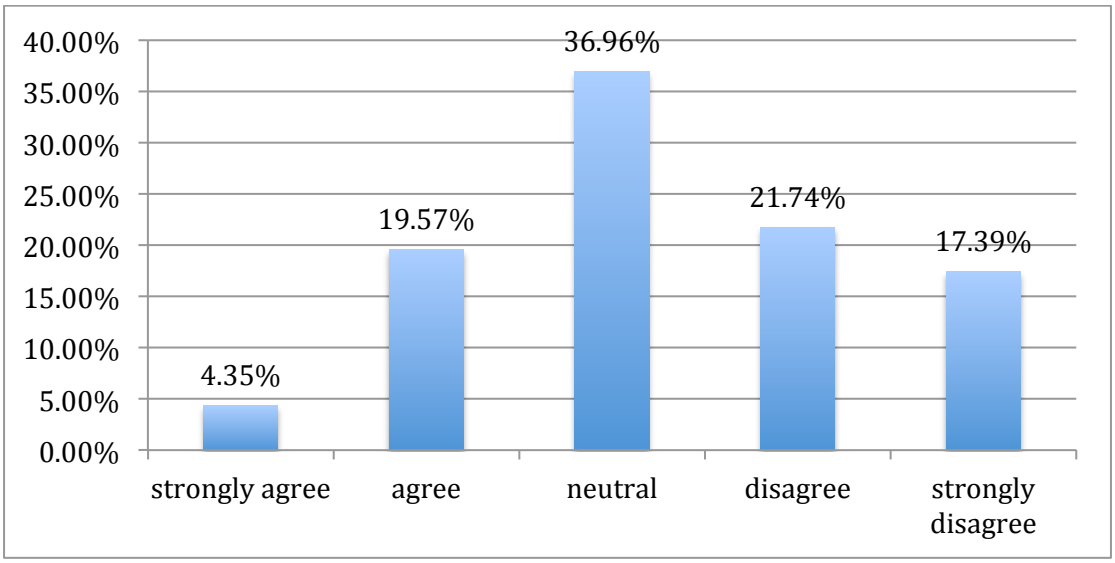

Figure 16 Post Survey: Using the technology helped me to perform better on the test.

One quarter of the participants (25%) as shown in Figure 16 agreed or strongly agreed that having access to the text to speech software helped them perform better during the exam. Over one third (37%) felt neutral about the process and over one third (39%) did not agreed that it helped them to perform better. It was not anticipated that every student would want to utilize the audio or would report that they found it to be a positive experience.

The results from the survey questions are interesting because students did not know the results from their exams and this uncertainty about their score may have influenced their answer.

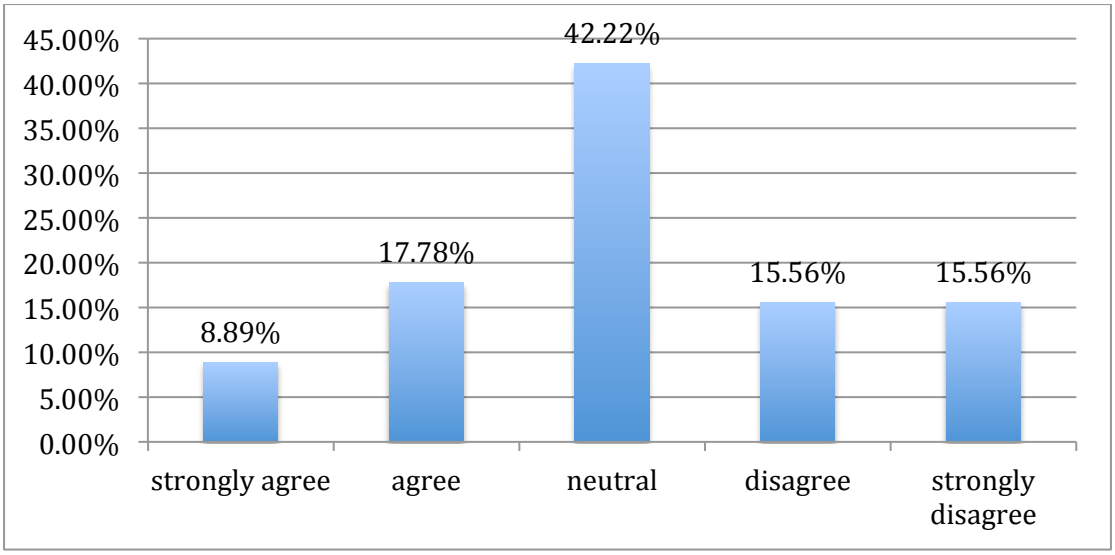

Figure 17 Post Survey: It was a satisfying experience to use the audio.

Figure 17 illustrates that one quarter of the participants (25%) agreed or strongly agreed that they were very satisfied with having access to the audio version along with the printed version for the provincial achievement testing while almost one half (42%) were neutral about their level of satisfaction. About one third (31%) disagreed that they were very satisfied. It is possible that student satisfaction is related to the outcome achieved on the exam (ie: the mark).

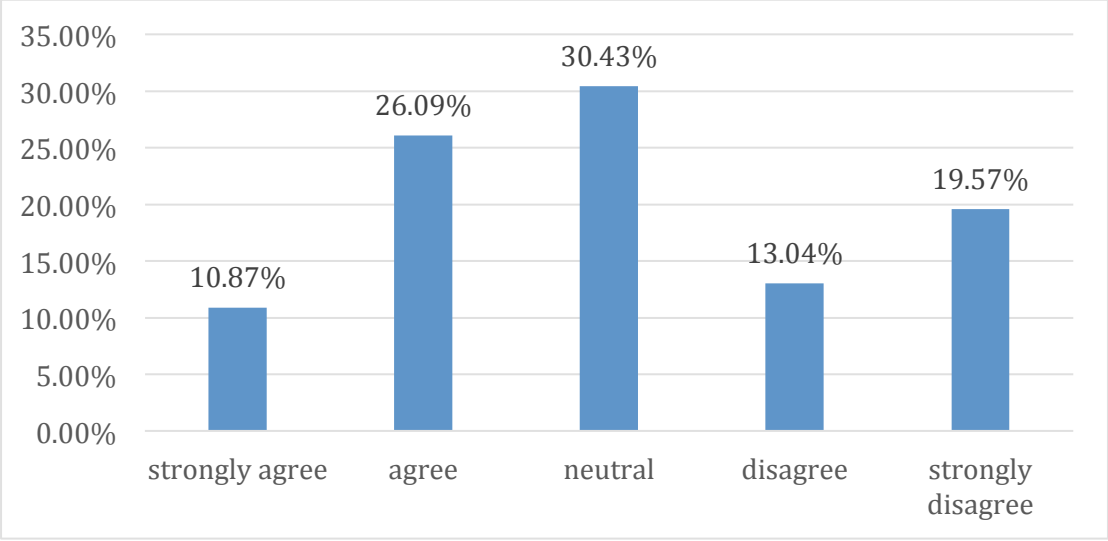

Figure 18 Post Survey: I would be interested in using text to speech or audio in future tests.

When asked about accessing text to speech or audio on a future test, about the same percentage of students (33%) stated that they disagreed and would not be interested, whereas about two thirds (67%) were neutral or agreed that they would be interested illustrated in Figure 18. Interviews enhanced clarity for students' interest including: space for using technology, confidence with technology, and own learning needs, which is discussed in the subsequent section. This result suggests that many of the students may access text to speech, digital audio or audio for multiple representation if offered the choice with consideration for some of the issues such as a larger desk size to accommodate the computer and more practice with technology.

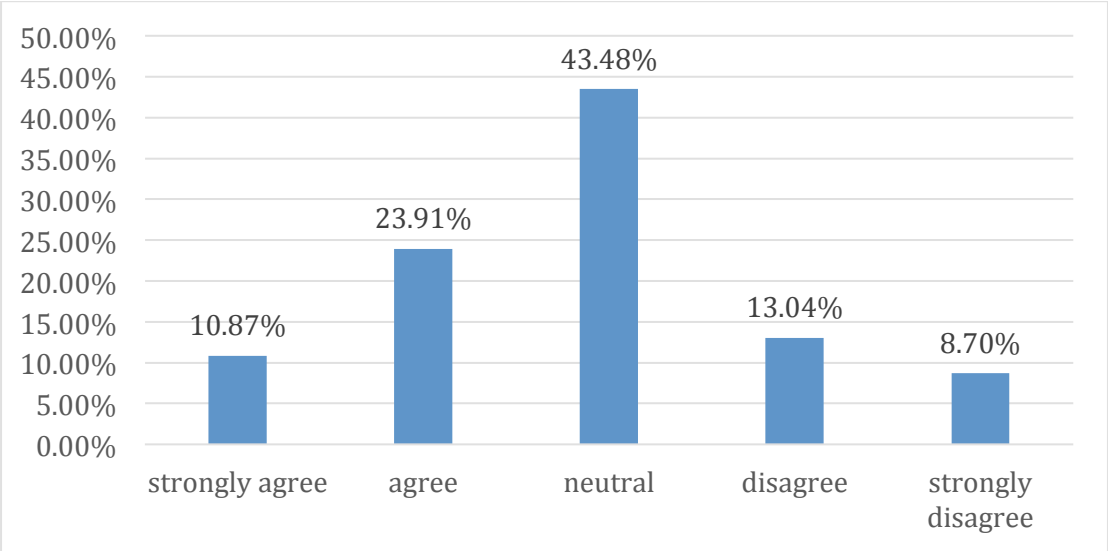

Figure 19 Post survey: I lose marks without the benefit of audio when I write tests.

Figure 19 shows that about one third (35%) of the participants agreed that when they write tests without the benefit of audio, they believe that they lose marks because of misreading questions. On the other hand, almost one quarter (22%) disagreed that they lose marks when they do not use the audio. It is important to

address the concern that students have about being assessed for mistakes: errors that are less related to the requisite content but are associated more with reading skill.

Utilizing Audio Version

During the provincial achievement test, just over one half (53%) of survey participants reported that they used the audio at least some of the time to support their learning as shown in Figure 20. If one considers that personal learning preferences may change from moment to moment, having more than half of the survey participants benefiting at least for some of the time, supports the value in providing the text to speech or other audio options. Of the participants over a third (35%) used the audio for at least half of the exam readings. Almost one half (47%) of the students did not use the audio. It is worth noting that the principal of one school stated that not one student used the audio for the provincial achievement test in mathematics even though they had utilized it during the class practice tests. The two teachers supervising the mathematics test did not put the computers out on the desks for the students. Both were unfamiliar with the research. The computers were in a laptop cart at the back of the room and students could choose to utilize the technology but, in order to do so, the student needed to pick up the computer and the audio CD before starting the provincial achievement test. Contrasted with this approach is the scenario in which the laptop and audio CD were placed on every student's desk before the exam started, and all the student needed to do was open the laptop and insert the audio CD. The possible impact for students will be addressed in the discussion section.

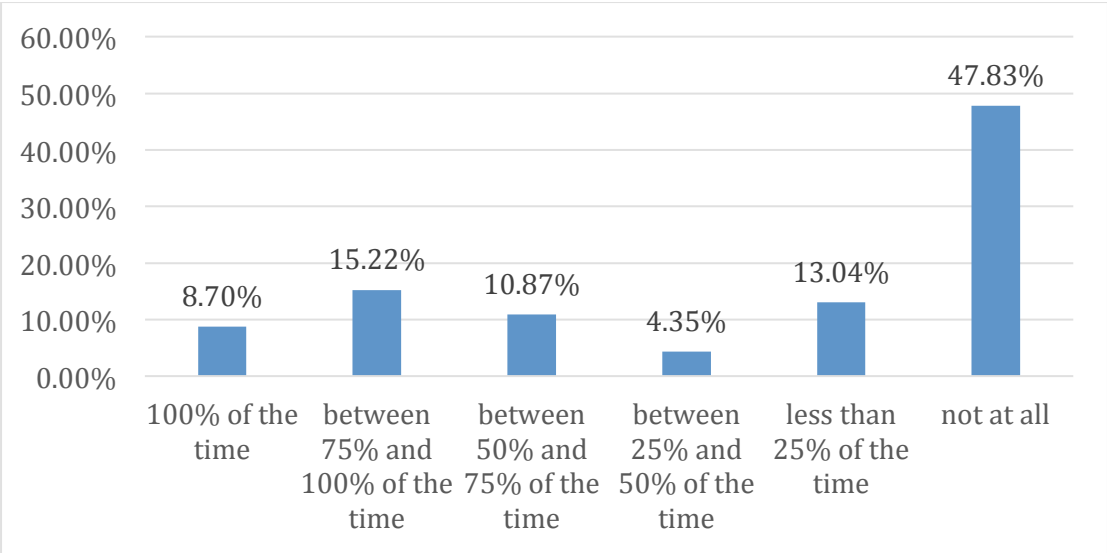

Figure 20 Post Survey: use of audio for provincial achievement testing.

Interview Results

Teachers and the grade nine students provided rich insights about their experiences and opinions. A total of eleven students and five teachers agreed to be interviewed from the two schools who had participated in the study shown in Table 2. There were six females and five males in the group of student interviewees. All of the students were in grade nine and approximately fourteen years old. Students were randomly selected from a group of volunteers other than attempting to have a mix of gender. If a student declined to be interviewed, another student was randomly selected.

Interviewees	Male	Female	Total
Students	5	6	11
Teachers	4	1	5
Total	9	7	16

Table 2: Interview Participants by Gender

Of the total of seven teachers whose classes were a part of the pilot study, five volunteered to participate in the individual interviews. After a face-to-face discussion with each teacher to explain the interview process and to invite the teachers to participate, they were informed that they were not obligated to participate in the interview and that they would be emailed individually to set up an interview time that would occur over the phone at their convenience. Five of the teachers responded with times they were available for an interview. The two teachers who did not respond to the third communication were not interviewed because it was important that they not feel pressured to participate, nor pressured to state that they were declining. Their lack of response to the email invitation was taken as an indicator of their reticence to participate.

Interviews for all participants occurred during late February 2012 and early March 2012. The sample of eleven students gave their views about the primary focus of this research, which was their level of satisfaction and experience with being able to access multiple representation for the provincial achievement testing. Students also addressed their use of computers at home and at school, any changes they would like to see and advice they had. It was also an opportunity for educators who were involved in the pilot to provide feedback and share their perspectives on the use of multiple representation for provincial achievement testing.

Transcription

The interviews provided insight about teacher and student experiences with the process. All interviews were conducted over the phone and recorded. During the data analysis stage the researcher first listened to the interviews while taking first impression notes for the purpose of collecting initial reflections on some of the

common threads through all of the interviews. After pondering first impressions from the interview data, the next task was to transcribe each interview. Although extremely time consuming, the transcription process was another opportunity to again consider what teachers and students were saying in response to guiding questions. The transcription process also helped with further review of the interviewing process and my own interviewing techniques. Although I was thinking about the interviewing techniques during the interview, reviewing my own recordings gave me further insight. I believe that preparing more questions than one would necessarily use beforehand would be helpful to prompt longer responses from the teenage participants who may not expand or reflect on deeper experiences or ideas without sub-questions.

Once the transcription was complete, responses were pulled together under each interview question to help with further exploration of developing themes. Each interview was further coded with multiple passes by creating margin notes as well as highlighting different phrases. Each interview was reviewed at least three times, and then the compilations were reviewed several times to look for finer nuances in the data.

Responses about School Experiences and Use of Technology

To promote a sense of trust and a positive start to the interview with students, the first question asked students to share a success they had experienced at school. Responses varied from being on the honour roll to being great at drawing to getting a very high mark in specific subjects such as Physical Education or Social Studies. Of the eleven students interviewed, five of them shared that they were on the honour roll. Perceived strengths included mathematics, technology, organization, drawing and

shop related activities. One student shared that reading was a personal learning strength.

Most of the students who were interviewed indicated that they find hands-on activities more engaging than reading textbooks or listening to lectures. Examples included lab work, creative projects and shop activities. Students had mixed opinions about what they viewed as less difficult. Some students really liked group work and found it less difficult whereas other students disagreed saying group work was difficult. This diversity in students' opinions parallels the broader literature related to the many ways in which students participate and engage in learning in classrooms.

Students indicated that time limits, reading, wording on test questions and writing using pen and paper were restrictive. Students also spoke of lack of fluid access to technology as frustrating. At school, students use school laptops occasionally for specific activities to support their learning, but as indicated on the surveys, most students typically utilized technology less than one hour a day.

One of the schools in the pilot had several class sets of individual digital media players that were used for a variety of activities including writing quizzes. The principal indicated that with the choice between individual digital media players or electronic whiteboards, the school chose individual digital media players because these created more opportunities for students to be engaged with the technology than an electronic whiteboard which had a stronger lecture focus for presentation than students interacting with individual devices. A number of students used their own mobile devices to support learning. All of the students indicated that they would like more access to technology devices at school such as mobile tablets, electronic whiteboards and laptops. Several of the students would like to see a switch to digital textbooks.

Many of the students use technology out of school especially for social networking type activities and searching the internet. Some students bring their own laptops to school to use in class. Technology access is not ubiquitous in the school or at home.

In summary, this information helped illustrate that students are diverse, yet most of the students enjoyed hands on type activities and all students would like more access to technology.

Responses about Access to Multiple Representation

One participant who reported a strong average (75% and above) in all course work indicated s/he liked using the audio version along with the written format indicating that having the audio helped her to better visualize what the sources were saying. This student used the CD to have access to the audio for the sources in social studies but not the questions. This student, although presenting as a strong reader, appreciated the audio support for the longer sources to reduce any confusion with the wording particularly in a testing situation. Being able to use the audio supports in one moment where needed and not in another would support the concepts of customization and personalization, which disrupted the "one-size-fits-all" format of assessment. The choice of using an audio format may benefit students as their learning and testing can be more personalized than having only one assessment mode (Collins & Halversont, 2010). The opportunity for students to choose the support for one aspect of the exam, such as having audio for the longer source material, but not for the shorter pieces aligns with the idea "offering flexible supports than can be

optionally accessed" to motivate students by having optimal challenges (Hall, et al., 2006).

Another student stated that having the audio "was really really good" and that s/he found it "really helpful having the sources read to me." This student concluded, "I think my confidence rose just in general because I know that I was really antsy right before the exam but having that audio there and having it read to me I thought I was really at ease and I was able to focus on what the questions were and what they were asking." This student reported having a diagnosed learning disability and would have likely qualified to receive the assistive technology support but indicated having access to the audio version along with everyone else, "didn't make me feel stupid. I don't like telling anyone that I am dyslexic, I normally keep quiet about it." This student indicated during the interview that s/he would advise other students to use the support because "you can have that extra support reading to you then you can correct yourself if you read it wrong." Thurlow (2010) argues that "accessibility features" provide support for some students while not disadvantaging others. This finding from this research pilot aligned with Thurlow's (2010) position. Research has demonstrated that students may be challenged by the traditional testing situation due to restraints on how they access information (Jimenez et al., 2007; Pisha & Coyne, 2001; Rose, 2000). When students who qualify for supports, such as text to speech or audio, large print or braille are set up in an isolated situation away from their peer group, it may make those students feel isolated and stigmatized (Spooner et al., 2007).

One student who used the audio for the part of the exam stated, "I liked having the audio because if I did not understand a question I would find it on the CD and it would read it to me and then I understood. I am a strong student and even though I have an 80 average I liked having the CD because it helps me when I am able to hear

information." This was similar to another student who reported holding an honours average who affirmed that the audio was really helpful, "I learned that using the computer and audio support helped." This student would be perceived as a strong student who would not need assistive technology. This student reflected that being barred from using the audio because of a high average "would be unfair because smart people can learn from the experience of having audio too."

Marino (2009) proposed that when cognitive load is reduced, students may be able to more readily focus their energy on figuring out answers, which may impact the experience and performance. Scaffolding through cognitive supports can improve performance (Quintana, Reiser, Davis, Krajcik, Fretz, Golan, Kyza, Edelson, & Soloway, 2004). When reading is not the purpose of the assessment, an audio version can provide scaffolding throughout the test or for small pieces of text as deemed necessary by the learner.

One student who was interviewed reported using technology ubiquitously and indicated a preference for using pen and paper for tests. This student stated, "I like the idea that you get to choose but I would not personally choose it because I found that having to listen to the question was slower than reading it and it would slow me down because I could not think with the talking." This student thought the study would help "to find a compromise to make the students' learning experience the best that they can have it" based upon their choice of learning preferences.

In summary students liked that multiple representation provided options for perception of the test material that they did not typically have for more formal assessments. Students who typically used extra accommodation such as audio liked that it was offered to all since it reduced the "singling out" that they had felt in the past. Multiple representation was about choice, not accommodation.

Responses about Technology Use

All students interviewed had used technology in some capacity at home and at school. During the interviews students indicated that they have more freedom at home to research things and use the computer for completing school work then they do at school. Students' experiences with technology varied although they had similarities in their familiarity with using mobile devices and social networking. Students' also had shared experience with their exposure to technology at school. Students clarified that they used calculators during tests and students with diagnosed learning disabilities could utilize reading software or use the computer for composing answers. Some participants also indicated the class occasionally used the class set of individual digital media players for quizzes.

In the interviews students indicated that part of their reticence with using the technology during the provincial achievement test is that the computer took up considerable space on their student desks, which made it awkward to manipulate the written portion. This was especially amplified for the mathematics exam with the extra material such as the formula sheet, rough working sheets, calculator or geometry set in addition to the hard copy of the exam. One student suggested that having the computers on larger tables rather than student desks may be helpful for managing the audio with the hard copy written format.

It was interesting to get students' perspective about changes they would like to see. Some students did not see how school could be changed through technology resources such as assistive technology in assessments because they have not experienced fluid access to these resources and seemed to understand the restraints. Several students indicated changes they would like to see, which included having more freedom to use their personal devices at school such as using their own mobile

technology in the classroom for research, taking notes and completing assessments. This would mean that students may be able to use the technology organically as one of the options for engaging in learning. One student suggested that technology use for assessments may increase with the addition of more laptops.

Three of the eleven students who were interviewed did not use the audio for their PAT for different reasons including feeling more comfortable using the printed format alone because of familiarity with it in a testing situation, not wanting to get up to retrieve the computer, and believing that the audio interfered with their thinking. All eleven students indicated that it was important for students to have the opportunity to exercise their prerogative for using technology supports to access the audio version along with the printed format.

Students had written most exams with the exception of the mathematics and or social studies exams in the gym. It was interesting that most of students commented that they liked being in the classroom more than being in the gym as it provided a smaller, less open space whether or not they utilized technology. The classrooms were used only to facilitate the computers for the study. The traditional logistics of taking large-scale standardized tests in gymnasiums impedes on the possibility of providing this option on a large scale.

It was not anticipated that all students would use the audio all of the time. Having access allowed students the opportunity to choose this support or not. One student concluded, “I learned that I don’t need the audio so I did not choose to use it.” This student had used the audio during the practice sessions but had indicated in the interview that the audio was distracting because it was slower than student read. Another student comments included, “I learned that using different parts of your brain can help you learn better. Having access to technology and [digital audio] was a lot

more helpful than I knew before" and "I learned that you could use the audio when you needed like for social [studies] but not for math [ematics]. The sources had a lot of reading and it was great to be able to listen."

In summary, the student responses about technology use indicate that they had would like to have more access to technology at school in order to suit personal preferences. The students liked the idea of being able to use their own devices. They also clarified some of the difficulties with using computers including the space restriction on student desks. The laptops at school tend to take up much of the student desk, which makes it difficult to have other materials comfortably accessible. The classrooms may not be set up to readily use other more mobile devices such as non-school netbooks, tablets or individual digital media players.

Advice from Students

When asked in the interview if a student had advice to offer for other students the comments were illuminating. Several of these statements included

"I would say that it [audio CD] can be really helpful at times,"

"I would definitely tell them to try it [audio CD] because it might be right up their alley and might help them to be more successful,"

"I would say that it [audio CD] is based on personal satisfaction and my friend said that she really liked it".

All students supported the idea that students should try it to figure out if it worked for them. One particular student who reported being very strong academically asserted, "every school would probably benefit from having audio [versions of the test] because I know that I did and lots of my friends benefited too." The salient point is students appear to perceive universal access to assistive technology as a natural

option for all test takers. They did not see it as specialized for students who are "different" or requiring extra support, which is an organic view of diversity. Taking a universal design perspective would allow all students to access alternatives to print or with print without the diagnostic criteria that is presently required.

Another student summarized that students could use it for the pieces of the exam that were less clear, stating that students could, "use it for any questions that they did not understand, but to be careful with the time constraints." Again this demonstrates that students may consider all of the options for creating the best situation for their circumstances. Like other options for supporting learning, such as dictionaries or calculators, students would access when they perceived they needed it.

Students offered strong advice to the Alberta Education ministry and school districts with statements such as "personalizing learning provides the best opportunities for the student. Being able to make your own choices is important." This statement aligns with researchers who believe that universal design provides opportunities for students to access, demonstrate and engage in learning in multiple ways (CAST 2012b; Edyburn, 2011; Jackson et al, 2005; Meo, 2008; Rose, 2011). Allowing access to assistive technology for all students recognizes that a print heavy environment may create barriers for some students who may not be identified for special education accommodation. Other students may have a stronger personal preference for listening or listening and reading. The audio version along with the printed version affords choice.

When a student says "I would say thank God if I could use the audio CD all the time," it is indicative of a level of relief about having the opportunity to access text in alternative format. Perhaps this is not necessary for every student in every situation but as one of the options that is not exclusive for specific students.

One student appeared to understand that if print is a challenge for a student than the audio version would be a great way to assuage this problem indicated in the statement, “I would say that it is a good idea to make [audio] available to any student who wanted audio on the exam because it helps them to be more successful than if they had to just read it especially if they were not a strong reader”. The students overwhelmingly advised other students to try the audio or text to speech to determine personal preference. Although the size of the population means that any advice could not be generalized to the whole group of grade nine students in the province, it did provide insights about this particular group.

Teacher Interview Responses

Teacher perspective also added valuable insight to this research. The teachers interviewed ranged in experience from five to twenty years in the classroom. They all thought that providing students with access to multiple representation was valuable. In supporting this alternative delivery of assessment, a couple of teachers noted the logistical challenges that would arise for the availability of resources to make that happen on a consistent basis. All teachers remarked that they were pleased that their students had the opportunity to access the audio version along with the printed format. One teacher said that he felt that his students would benefit from being able to use the audio version plus the printed format of the provincial achievement test commenting “I wish it [multiple representation] would happen more often [in provincial exams].” Another teacher supported the use of multiple representation for large-scale assessment in the statement. “It would be great if the audio [along with the printed format] was accepted as practice for final exams.”

Teachers believed that the choice was important as students learn more about themselves and what they need to demonstrate their learning. Simply stated by one teacher, "I like the idea that students have choice [for access on the exam]," indicates that this teacher likely promotes choice within the learning environment of the classroom and would like to see that carried over to the standardized testing environment.

Teachers speak about the variation in reading abilities within their class and were keen about student having access to the audio version with the printed format and as one teacher stated, "[multiple representation] is great for reluctant readers."

One teacher stated, "We cannot fit everyone in a box," with further insight that his students may know the material but their learning needs are not the same and their experiences writing tests are not the same. He indicated that he thought that some of the students are compromised by the print barriers created on a large-scale assessment when they are unable to read at the level of others who are also taking the test. This aligns with literature from researchers (Edyburn, 2006; 2007; Hitchcock et al, 2005; Rose & Meyer, 2002; Rose, 2011).

Concerns from teachers included the "precious minutes" it took students to go back and forth from the computer to work with the audio version to the printed format with the idea that time structure needs to be addressed for this scenario either with fewer questions or a longer time frame. A question from one teacher was "why should there be a time limit?" Student fatigue or stress may be exacerbated by the using technology during test taking because of their lack of experience with fluid access especially when the process has inefficiencies that can be time-consuming (Salend, 2009). Salend (2009) contends that read aloud items using a computer can take more time than typical test taking and therefore "make some test items more

difficult" (p. 50). It is important to consider that students may need more time for test writing that utilizes audio. The amount of extra time needed would be influenced by students' experiences and adeptness at using the school regulated technology as one teacher pointed out, "if it is just for listening, [individual digital media players] were easier to deal with in an exam than the computer."

Emerging Themes

> *Teachers and administrators need to examine student performance data in more meaningful ways, and to evaluate the extent to which new approaches to curriculum, instruction, and assessment actually result in higher levels of student learning.*
>
> ~Lachat, 2003, p. 213

The themes were tracked through multiple highlighting with different colors. From there as preliminary themes arose, the data was copied from the interviews and organized under headers. Four main themes emerged from the coding and were constructed based on experiences or insights from teachers and students. First, UDL supports diversity of learning for students who are inherent in all classrooms. Given what research conveys about the complexity in classrooms, UDL may provide guidance for helping to consider how to address the barriers that can be present if the curriculum is does not account for variation in learners. Second, UDL in assessment is in its infancy and facilitating accessibility was a positive step in this study. It is still limited since the printed format is the usual manner of distribution. Third, technology restraints may compromise how UDL is facilitated in classroom activities and assessment. Finally construct irrelevance does compromise some students when they write tests. These themes will be discussed in detail using the study data as well as the research literature.

UDL supports Diversity

In this study, it was found that having choice for access allowed diverse learners more flexibility in how they approached the test. Student reflection supported the value of choice and acknowledged that although not everyone would need multiple representation, the diversity in the student population required consideration, which would honour the range of student needs. One student, when asked what she had learned from the study stated succinctly, "I learned that everyone learns differently so it is good to find a way that supports people in their learning." As students have more opportunity for choice, they may build their individual capacity to choose options that help them perform optimally (Alberta Education, 2010a). This choice may increase motivation, engagement and satisfaction (Alberta Education, 2010a).

Multiple representation, a principle of UDL, offers different alternatives for visual or auditory information so that students can access the material in a manner that works best for their individual learning needs. All teachers and students who were interviewed believed that having access to the audio version along with the printed format of the material during the provincial achievement tests provided choice and was a positive step for meeting diverse needs. This paralleled other studies about incorporating universal design into large-scale assessment (Almond et al., 2010; Dolan et al., 2005; Salend, 2009).

As UDL becomes more integrated into learning and testing environments several things may happen. First, those students who are already identified as requiring support are included in the whole group since the assistive technology is not a separate entity that secludes or stigmatizes the student (CAST, 2012a). Second, the students who are not identified but could really benefit from the support may access

it. Third, multiple representation as one of the principles of UDL accounts for learner differences in reading ability which may be compromised in a testing situation (Meo, 2008; Jackson, 2004). Utilizing a principle of UDL in the large-scale assessment acknowledges that there may be barriers for students, even those without diagnosed learning needs (Messinger-Willman & Marino, 2010; Salend 2009).

Reducing the barriers to print may reduce frustration and sense of failure (Edyburn, 2006; Messinger-Willman & Marino, 2010; Salend, 2009). Some students believed that being able to use the audio meant that they reduced the chances of misreading questions. Offering multiple representation through assistive technology in the large-scale assessment for all students may help dismantle barriers thus increasing level of satisfaction and respects that not all students are the same (Messinger-Willman & Marino, 2010; Meo, 2008; Salend, 2009). Even students who chose not to utilize the audio because it did not meet their needs thought that having the choice was an important consideration. The participants in this study understood that providing alternatives to print only format is a viable way of responding to learner diversity.

Facilitating UDL in assessments

Providing universal access to assistive technology illuminated that it is possible to provide alternatives to print only for the provincial achievement testing. It does offer promise for understanding how alternative versions creates more satisfaction with test writing and is worth exploring further. Although the large scale standardized testing such as the provincial achievement tests are limited in the type of supports that can be offered, providing audio as an assistive technology would not compromise test security or test construct for determining student knowledge.

Permitting it for all students would make it an ordinary part of the exam writing process, which would reduce the stigma that some students feel about needing specialized support, while providing it to students who may be marginalized because of the barriers presented by print. The goal of the provincial achievement testing is to determine content knowledge, not reading level.

Several of the teachers commented that they were pleased that their students had the opportunity to participate in the study. Based upon their experience the teachers thought that being able to offer multiple representation as a universal design on large-scale assessment was very important because one approach is not really fair to students who may be compromised by weaker reading skills. Rose and Meyer (2002) note that traditional assessments have four weaknesses that if addressed may create more valid tests.

1. student characteristics—individual learning differences—can confound results
2. media characteristics can confound results
3. withholding student supports can confound results
4. poor integration with curriculum limits the value of assessment data, (p. 139).

For this study, at least some student characteristics and students supports were considered by providing accessibility to audio along with the written format. The audio would be beneficial for addressing more individual learning differences, which was helpful according to the teachers and students who were interviewed. It also meant that the audio support was not withheld.

When the Ministry of Education is willing to provide multiple representation through alternative formats on large-scale assessment, it provides a perspective that students learn in different ways and having choice personalizes the assessment to account for diversity. Having multiple representation available universally in large-scale assessments provides a model for basic accessibility that may encourage more

teachers to consider the impact of print only assessments inherent in many high school academic courses.

To facilitate universal design for provincial achievement testing, schools could be offered the opportunity to provide access to text to speech or audio for all learners. This would be similar to the opportunity to participate in Quest A+ right now. Not all students would choose to use Quest A+ or text to speech or audio. To move toward a fully accessible exam, perhaps initially students could indicate their interest ahead of time so the ministry can provide the appropriate resources and schools could set up for those students who need and those who prefer to access multiple representation. Students would not be declined because they lack the appropriate diagnostic criteria that are presently required. Access to all aligns with the belief that a "differentiated approach supports and inclusive education system in which all students have the best possible learning opportunities" (Alberta Education, 2010a, p. 116).

Other research illustrates that utilizing universal design in large-scale assessment is a positive step to addressing diverse needs (Chudowsky & Pellegrino, 2003; Dolan et al., 2005; Edyburn, 2006; Ketterlin-Geller, 2005; Pellegrino & Quellmalz, 2010; Thurlow et al., 2008). The participants in this study thought provision of multiple representation for the provincial achievement tests affirmed that the Ministry of Education recognized that not all students learned the same. The participants were in favour of individual choice to suit personal learning preferences.

Technology Restraints

The first issue with technology, addressed by all teachers during the interviews, is the fluid access during the semester continues to be a constraint as schools thoughtfully consider how to make the best use of their technological

resources. The technology capacity appears to be growing but one to one access is not a reality for many schools. There are obvious issues to do with access to technology that would need further consideration for widespread use of multiple representation on assessments. Right now the schools in this study did not have enough resources for students to be provided with alternative formats on all assessments all of the time since these resources were shared across the school. This may be an issue for many schools. Further research about how to plan for technology resources that help diverse students in their learning will be important and "given the choice between investments in technology that enhances teaching, and investments in technology that enhances learning, preference must be given to the latter (Edyburn, 2011, p. 42).

A second technology constraint occurred during the provincial achievement testing. In the interview a couple of students indicated that one problem was that the size of the computer impeded the space they had to work in because the student desks are small and the laptops crowded the space. Two student comments summed it up with the statements; "it would have been better with big desks where you can have all of the planning pages out and still use the computer" and another student said "it would be a better experience if the desk had not been so crowded." A teacher stated, "students were deterred from using the laptop during the PAT because it took up valuable space that they could use to spread out things like the formula sheet, calculator and working scrap paper." This statement was supported by another teacher comment, "one negative was environmental with the biggest thing was we were using a laptop to play the sound and the laptop took up an enormous amount of space on the [students'] desks." Obviously the space crunch needs to be addressed to make technology use easy and not a situation where a student had to choose the computer over space to work by hand.

The environment is an important consideration for figuring out how to use the technology while not crowding students. This space crunch was one of the explanations for the difficulties suggested in the post survey when almost a third of the participants commented that they had experienced difficulty. It was a significant issue for the mathematics exam because students needed to be able to spread out formula sheets, working rough copies, the printed copy of the exam as well as the seventeen-inch laptop for the audio. The teachers' statements were supported by the same sentiment from students. It may have resulted in students declining using the assistive technology so they could have more space.

The third technology restraint impacted at least two students who stated in the interview that the computer cut out on them and they had to get help to get the technology working again which was a source of duress especially with the rigid time restraints. Technical failures while participating in learning, and especially during large-scale assessment, are a source of frustration. One teacher indicated during the interview that having more technical support for the technology that is available at school would increase opportunities to proactively use it in learning tasks.

Construct Irrelevance

The social studies test, in its traditional format, entails substantial reading in order to answer the questions, although reading is not a required component of the assessment. The mathematics test would also require the student to read in order to answer questions. Even though the assessment is meant to measure content knowledge, without a certain competency in reading, students may experience dissatisfaction with provincial achievement tests when they experience difficulty with decoding or fluency. This experience may lead them to lose confidence, which may

ultimately compromise their demonstration of knowledge (Pisha & Coyne, 2001). Three of the five teachers interviewed expressed frustration that the reading level required to complete large-scale assessments in general may interfere with students' ability to demonstrate content knowledge. There is an assumption, as one teacher stated in the interview, "that everyone reads at the same level and comprehension is at the same level; the playing field is not level for those [students] going in there so the assessment tool doesn't really assess what they know."

A number of teachers indicated in interviews that they thought access to the audio version may help reduce construct irrelevance. Hitchock, Meyer, Rose and Jackson (2002) affirmed this idea that scaffolds "helps students overcome media related barriers and show what they really know" (p. 14). With any large group of test takers, the diversity would suggest that the alternate formats may be beneficial. Students indicated that they were sometimes frustrated during the semester when they looked at a test after receiving the results and recognized that they knew an answer but had misread the question. When two students who both have strong knowledge of content but have different readily abilities, one student may experience more satisfaction with a printed format and may perform better because of reading skills not content knowledge (Haladyna & Downing, 2004).

During the interview, students who consider themselves to be strong readers still said that they found having the audio version along with the printed format a satisfying experience because they believed that it helped them reduce the number of reading errors made in a test situation. One student when asked about whether other students should consider using the audio version along with the printed format illustrated insight about considering personal preferences when (s)he stated, "if they are really strong readers I would say it may slow them down but if they are not strong

readers I would say it is a good idea." One teacher stated that the audio version allowed for more fluency in the comprehension of questions since students may not fully understand a question even though they can read. When a test is more accessible by reducing the impact of a construct irrelevant variant, then the assessment is likely to better address the diversity of learners.

This fourth chapter provided an interpretation of results from pre and post surveys and interviews that were used to determine coding. The four themes that emerged from an iterative analysis of multiple sources of data contribute to further understanding of how universal design helps to address student diversity during assessment situations, facilitates the integration of universal design into large-scale assessment, illustrates the technology restraints that may influence the process of integrating universal design and sheds light on the impact of construct irrelevance.

Chapter Five

DISCUSSION, CONCONCLUSION AND RECOMMENDATIONS

> *Advocacy and leadership spark the evolution of educational processes and create the energy that fuels the fires of educational innovation and excellence.*
>
> *~ Jacobsen, 2008, p. 3*

This final chapter summarizes how the research question was answered through the key themes while presenting the overall findings for this study. The chapter also includes recommendations regarding the research question and identifies further research possibilities. The study was designed to explore the research question, *how does access to multiple representation through an audio format, such as audio CD or text to speech, and written format, affect students' satisfaction with writing the grade nine social studies and mathematics provincial achievement tests?* Several questions helped to frame the data analysis and reporting: What were students' perspectives? What insights did teachers contribute to the study? How did the quantitative data align with the qualitative data? What challenges impacted the study? What were the celebrations? What are the new questions arising from this study? What are the delimitations?

The purpose of the study was to explore the current research related to my research question, identify the need, and then to contribute new understandings about how access to multiple representation on large-scale assessment affects student satisfaction. Given the development of Alberta Education frameworks, such as *Inspiring Action on Education* (2009a) and *Action on Inclusion* (2010b) this is timely research that can promote better understanding of the impact of increased access to universal design for all students in exam writing situations. The principal themes that were derived from the study include UDL supports diversity, facilitating UDL in assessment, technology restraints and construct irrelevance. These themes will be

discussed to frame the discussion about the research. This chapter considers the trustworthiness of the data, the professional implications, the research question, student views, teacher insights, challenges and celebrations, alternatives, generalizability of findings, limitations, recommendations for practice and recommendations for future practice.

Trustworthiness of Data

LeCompte (2000) asserts that as a researcher studies a topic, the question is, "Do I, the researcher, really understand and describe what I am studying in the same way that people who live it do?" (p. 152). Only when the analyzed data is perceived to be reliable with credible results will those involved be willing to use the study for future planning (LeCompte, 2000). I have worked in the field for over twenty years and found that my perceptions aligned with what teachers and students were communicating through the experience. I have worked with numerous students who have had similar experiences. I understand assessment and how it impacts students. This study was meant to provide research that would affirm the experiences of many students I have worked with over the years. Since I have expertise in the field but did not know the participants it was an opportunity to provide objective data from their lived experiences without being influenced by their relationship with the researcher.

The survey helped to provide an overall perspective of students' perceptions about access to multiple representation. For example the survey data indicated that students' opinions were along a continuum from limited interest in multiple representation to multiple representation being regarded as an important personal choice. The student survey provided sufficient data to triangulate with the interviews and notes collected during the study. The survey data did not appear to tell a different

story than the interviews, although some of the survey data were not as clear without the triangulation from other data sources. For example, a descriptive analysis of the survey data revealed that in response to several questions that used a "level of agreement" scale, many students opted for the neutral answer. Given the opportunity to repeat the survey, I would change the neutral answer into two levels of 'somewhat agree' and 'somewhat disagree' to require respondents to make a choice and thus seek a clearer picture of students' opinions on items using a "level of agreement" scale. If used in a future study, some of the survey items would be further developed with sub questions to clarify more of the information contributed by students, for example, a question that helps to clarify reasons for using the text to speech or audio including to help with difficult questions, use for longer source questions, or to clarify specific phrasing. Questions that clarify the types of technology students are using at school and at home would also be posed. For example, are students using electronic whiteboards, computers, individual electronic media devices or cellphones and how much time would be spent on each type of device? This would help build a better picture of how student are utilizing technology in their lives.

Informal dialogue with teachers indicated that while many students were intrigued with the idea of using multiple representation on tests, some students were worried that it may not be beneficial or may have a negative influence on their results. Student hesitation in using an assistive technology during exam writing might be explained by their relative lack of experience. For example, even though the students were given opportunities to practice using the audio on classroom tests, some students were using it for the first time on a formal exam and many had limited experience with using multiple representation for test writing. Student hesitation might also be explained by the culture surrounding exams, specifically, the perceived gravity of the

provincial achievement exam. For this reason, students may have been reticent about taking on anything new that might put their performance at risk on such an important exam.

The interviews proved to be critical data source for gaining more knowledge about these student and teacher experiences. The interviews also provided insights, that when triangulated with the survey data, explained that many students did perceive the universal design through multiple representation supported diverse student needs and that students understood that not all learners are the same.

In summary, given the triangulation and coherence in many of the data sources related to the key themes, this section was used to argue that the analyzed data is perceived to be reliable with credible results in this study.

Professional Implications

This mixed-method case study research provided insight about the defensibility of grade nine students being given access to multiple representation on a provincial achievement test. This study extends on the current research about large-scale assessment and UDL; an area that still has very limited exploration and clear findings. It contributes information from an Alberta perspective while aligning with research across North America. Creating a testing environment and inclusive testing culture that is more conducive for the myriad needs of all students was the motivation to explore this issue. Giving students a choice allows for personalizing how they access the exam. This research may be used to stimulate further dialogue about how universal design principles, such as multiple representation, incorporated into the structure of large-scale assessments have the potential to benefit all students without

compromising the accountability of the provincial achievement tests as they exists today.

In order to create an inclusive testing environment conducive to the needs of diverse students, multiple representation would need to be an inherent component of the exam to be a universal design as it is intended. However, at this point in Alberta, multiple representation is only available as an accommodation layered onto the exam as an assistive technology. Designing the large-scale assessments in Alberta to include an audio version along with the printed format and or the digital format to promote multiple representation may help to address the diverse learning needs of students better than a single printed format. It is not a "panacea" for all, but this study's findings indicate that UDL for testing may hold significant promise for many (Salend, 2009).

The narratives of the grade nine students showed that they wanted to contribute to the findings of this study by providing input on their own experiences about satisfaction as well as to provide advice they would have for other students and make suggestions for the ministry, other school boards and their schools.

Research Question

Does access to multiple representation provide satisfaction for those students who choose to utilize it? Based upon conclusions drawn from both qualitative and quantitative data given by participants in the study, the majority of students were satisfied with access to multiple representation during the exam.

Access is the optimal word. Students were not required to use the alternative versions of the exam but these alternatives were accessible to them. All students had the option to use the technology; many believed it would be beneficial to create a more satisfactory experience for demonstrating knowledge. Students could use

assistive technology for the whole exam or portions of it. Since it is difficult to ascertain which students would benefit, universal access is important to allow all students the choice to use it, not just those students who meet diagnostic criteria for learning challenges. It is the contention of this author, based on the findings from this study, that all students being tested for content knowledge should be able to access technological supports to help them demonstrate their knowledge of the content.

Students' Views

What did this study illustrate with regard to student views? Some students chose to access the audio version along with the print format for the study and some chose not to access it. Regardless of their individual decisions to utilize the assistive technology or not, students who were interviewed believed that it was important that access was available to all students and that the one size paper and pencil test was not necessarily the most appropriate way to test all students. While the focus was on utilizing multiple representation on large-scale assessment, this type of technological support does hold promise for further understanding that access to multiple representation in the classroom for smaller assessments would also contribute to student satisfaction through personalization. Satisfaction and increased confidence while writing exams are clear benefits of offering universal access to assistive technologies for some students.

Providing audio versions of a test along with the written format for those students who often misread test questions meant they had an opportunity to be more satisfied with the process since they could access support for miscuing without impacting the goal of testing content knowledge. One student in particular, who would be eligible to have the audio because of a diagnosed reading disability, thought

it was important that the access was universal since it neutralized her situation of requiring the support by offering it as a choice to everyone. Having universal access to audio was an option without any emotional barriers that can be associated with being segregated to utilize the assistive technology. Universal access to this assistive technology gave students who did not qualify for any accommodations, and who believed they would benefit, the affordance of utilizing multiple representation. In short, students appreciate a level playing field and not being specifically identified as distinctive from their peers. Secondary principals and teachers can make a difference and stem this cycle if they reduce or remove barriers to the curriculum that have long-term negative impacts on students with LD" (Messinger -Willman & Marino, 2010, p. 7).

Teacher Insight

Teachers were highly reflective and readily shared their perceptions of student experience by contributing insights from their prior experiences in teaching and also from their experiences with this particular pilot. All five teachers who were interviewed were positive about what multiple representation could add to the satisfaction of their students and, in particular, their readers who struggled or the less focused students who may benefit from the addition of audio along with the written format.

All teachers who participated in the interviews thought access to multiple representation as a personal choice during the provincial achievement test or other large-scale assessment was a positive step in better meeting individual needs without the requirement of meeting specific Alberta Education criteria. This may create a positive step forward toward more universally designed assessments. Teachers regarded access to multiple representation to benefit more students than just those

students with diagnosed learning needs. Although teachers did not believe that it was necessary for everyone, they thought that having the choice to access multiple representation was important. Meyer and Rose (2000) posited that UDL "accommodates variations in background, learning styles, abilities, and disabilities by providing flexible materials and learning experiences that suit the learner and maximize his or her ability to progress" (p. 5). Teachers concurred with Meyer and Rose's (2000) research and observed the benefits with their own students.

One teacher thought that students need opportunities to access multiple representation on an ongoing basis so that it is not foreign, not just in the semester prior to the provincial achievement testing and not just for the one or two subjects but also as an integrated practice. According to this particular teacher, the practice tests, while useful, would not have been enough exposure since "through their entire school career, the vast majority of [students] were never given that opportunity before" and that this preparation may have been too much out of students' comfort zone. Brinckerhoff and Banerjee (2007) posit that having universal access to technology and technology aids for all testing "is not a simple task" even when considering just those students who have disabilities. Students may not have the skills to use the technology in a testing situation, the technology may not work as smoothly as anticipated which may create stress for a student, and there may be realities with restricted resources.

The findings from this study are similar to recommendations in the research literature. Students need to be fully accustomed to assistive technology such as text to speech or audio before using it on the large-scale assessment (Brinkerhoff & Banerjee, 2007; Ketterlin-Geller, 2005). Still, having ready access to assistive technology during class time for other activities and exams for all students may

present significant challenges in many typical educational situations because of the paucity of technological resources. Several of the teachers interviewed expressed concerns about taking the time to prepare students to employ strategies and use available tools for testing, whether summative for the school or large-scale for the province. Without a commitment from the province that universal access to multiple representation would be available to all students, teachers remain reticent to incorporate tools, such as text to speech, that would have to be stripped away during these large-scale assessments whether for the provincial achievement testing or the diploma exam.

Since the universal design principle of multiple representation is not typically available to all students on the Alberta large-scale assessment, teachers may be hesitant to provide it for classroom assessments even if the resources were in place. Several teachers indicated in interviews that they do not want to put students in compromising testing situations where students would have to perform using fewer strategies or tools than they can use in their typical classroom testing. Teachers often model the multiple-choice tests for their summative assessment on what students would experience for the large-scale assessment. This classroom modeling and practice tend to help with preparation for large-scale assessments such as the provincial achievement tests and diploma exams. If the Ministry of Education were to provide universal access to multiple representation on large-scale assessments, then this action would demonstrate that this universal access is viable as part of the overall assessment strategy and would go a long way in encouraging more teachers to consider its value.

One concern expressed by a teacher during the interview process was about whether the additional supports would create unrealistic expectations of what may be

available in the world beyond secondary school into post secondary or the workforce. The teacher thought that students may not always get information relayed in audio format and setting up that expectation may be deleterious. In a future study, this research would like to survey whether this teacher's opinion is widespread, and explore the implications of this pedagogical stance. For example, do technology supports such as open source screen readers provide more access than is commonly available outside of the K-12 environment? Researchers are exploring how the capacity for UDL is being integrated at post secondary (Burgstahler, 2008; Campbell, 2004; Roberts, Park, Brown, & Cook, 2011; Schelly, Davies & Spooner, 2011). With the widespread access to mobile, personal devices, such as smartphones with text-to-audio capability, and audio-to-text capability (i.e., Apple's SIRI), then this teachers' concern may be a moot point as society adjusts to the advantages of having widespread access to assistive technologies. It may turn out that schools are the only place that citizens are prevented from having this access to assistive technology.

Challenges

The conditions for utilizing multiple representation on the large-scale assessment were not ideal since students did not have broad background experience with accessing audio through using technology for audio or text to speech fluidly as part of their regular classroom activities and assessments. Other than their practice tests leading up to the provincial achievement tests, students cannot access multiple representation on a daily basis in the classroom nor is it available for typical testing situations. Did this lack of experience influence their decision to participate? Although students were not jeopardized by the study since they did not have to participate, some students may have been reticent about the process because of the

lack of experience even with the practice tests using the audio. It was not a tool they had grown accustomed to using. "Testing requires a confluence of skills, some that represent the construct of interest and others that reflect ancillary processes involved in engagement with the material" (Ketterlin-Geller, 2005, p. 4). Like many large-scale assessment, the provincial achievement testing, in its present format, is not designed as a universally accessible test and accommodations are "subsequent to conceptualization and development" through audiotaped versions or large print version that are secondary to the primary presentation (Ketterlin-Geller, 2005). This relative lack of access can create issues with students' individual experiences and comfort level with the accommodations. According to Ketterlin-Geller (2005), a universally designed assessment may have more benefit for all students than attempting post hoc accommodations. Additionally, as previously mentioned, universally designed assessments need consideration for classroom assessments as well.

In the interviews teachers indicated that access to assistive technology is determined by how much time each class can have with the computers since it is a shared resource in the school that needed to be booked in advance. Booking access to technology during the final exams may be slightly easier to organize since the whole school is not typically writing exams at the same time and the technology can be timetabled for specific tests. During the regular semester, planning to have universal access to assistive technology for all quizzes or unit finals remains a significant challenge with limited technological resources that are shared across the school population. Students indicated that they would like to be able to use the computer at school to conduct research and use technology supports more frequently than is presently available.

As technologies are improving they need to become more integrated into formal learning environments as they are in informal learning. Every student may have the capability in their hands to personalize every moment of their learning as schools make more technology available either through school resources or providing network supports for students to bring their own mobile technology and handheld devices.

Celebrations

One teacher was passionate about the notion that school has to be relevant for students and that to be relevant it is important to "get to the [students] level" by providing the scaffolding that is necessary to build learning success. When students have the appropriate supports, according to this teacher, they "are willing to put the extra effort in." This teacher gave an example of the nice surprise that one of the students in the class passed the provincial achievement test using the audio format when the same student had struggled in the past to pass without the audio and would not have qualified for the support using the criteria for learning disability. The teacher believed audio did make the difference for this student in particular and also for other students. "Resources with flexible formats give students the choice, control and independence they need to be successful in their learning" (Alberta Education, 2010a, p. 94)

Edyburn (2006) suggests that when students struggle to perform they have lasting "emotional scarring" that lead students to believe that they do not like the subject. One of the teachers in the study passionately spoke about his experience of speaking with students about their preconceived notions about who they are as students of mathematics based upon their previous experience and even the

experience of their parents. Can scaffolding via multiple representation be a difference maker? Will students have a more neutral view about studying subject material if they had the supports that help to create access for content knowledge? Future research is clearly needed to help us to answer these questions because it is very clear that the one-size-fits-all approach to teaching and testing creates barriers to curriculum, to test writing, and creates misconceptions about potential (Edyburn, 2006).

One of the teachers relayed that many of the students were very excited about the opportunity to access and audio version along with the written format on the exam and summarized that there were three positives coming from the students about providing technology to accommodate the universal design principle of multiple representation. First, the teacher recalled that the students were excited that audio would be "giving me something else than can help me be successful." Second, the teacher emphasized that the students were happy that the school was "willing to go that extra mile" to create better access to support success. Finally, this teacher thought the learners who had difficulty reading recognized that access to audio supports provided a better opportunity to be successful. The teacher stated that "the motivation coming in was higher" for the students so perhaps the experience was more satisfying. Staff were encouraged that the ministry saw value in the research by enabling them to participate in this pilot with the technology.

Alternative Explanations

An interesting scenario happened during the mathematics exam at one school. The computers with CDs were not placed on student desks with the written exam for the mathematics exam. Students were invited to go pick up the computer and CD

from a laptop cart at the back of the room if they wanted access. In this situation every student declined using the computer. Why did this happen? Were students reticent to identify that they may need it or benefit from technological support during the exam? If access were at every desk would more students have chosen to use it? Were students fearful of being identified as "needing" the support by going to get it? Or was it simply a matter of students feeling the time pressure of the exam and choosing not to take the time to grab a laptop? Is it fair to say that teenagers would not want to stand out? What emotional barriers would influence decisions not to "stand out" by going to get the computer and audio CD? A comparison between the two exam scenarios, access on the desk and access from the cart at the back of the room, clearly supports the contention that if access were at every desk then more students would have chosen to use it. More research is needed to address the questions that arose from these two different deployment scenarios.

Students, especially teenagers, do not like to stand out as needing more support than their peers. Providing a variety of options that are not perceived as special accommodations reduces stigmatization, increasing the likelihood that students who need supports would consider using them. Providing choice for access to all students allows those who may not be identified by formal diagnostic criteria to utilize supports to better demonstrate their knowledge.

Generalizability of findings

This pilot was meant to introduce findings that could be further developed in subsequent research studies. As a mixed method study with a focus on exploration and use of qualitative data from a relatively small sample, the findings from this research cannot be generalized to a larger population. However the study does

provide evidence of benefit with this specific population. The research suggests that further investigations would be a viable next step in figuring out how a larger population of students are impacted by being given permission to utilize multiple representation on a large-scale assessment such as the provincial achievement tests or the grade twelve diploma exams.

Limitations and Delimitations

This pilot was meant to generate research findings that could be further developed to impact practice and to inform subsequent research studies; the study was successful at achieving both of these objectives. However, the study was limited to a small group of students in two rural schools. Although the students and teachers at these schools certainly seemed typical of many other teachers and students at this grade level, given the size of this study, it cannot be generalized to a larger population. To broaden perspective the study would need to be larger taking in more areas of the province in order to make generalizations about the grade nine population as a whole. It does demonstrate that further investigations would be a viable next step in figuring out how a larger population of students writing either provincial achievement testing or diploma exams are impacted by being given universal access.

There are a number of other limiting factors in the study.

- Students do not always recognize their own learning needs/strengths and may have chosen not to participate when they may have benefited.
- Providing teachers with more professional development about UDL may help with the integration of principles of UDL in classroom assessment.
- Access to sufficient technology and digital versions that have text to speech capability of written text were not a part of the regular classroom practice, and

students may have been reluctant to use the technology because of previous lack of exposure and practice. Having more time for students to have ample exposure and experience with utilizing multiple representation in a variety of classrooms activities and assessments would improve the study.

- Universal access should not require that student to self identify in order to learn whether multiple representation may be a benefit. Part of the pilot was limited because students were required to get up and retrieve the technology from the back of the room during the time limited testing situation. Ready access to the technology on the desk during the testing situation appears to neutralize any stigma associated with requiring extra help. It is there for all to access. Retrieving a computer and a CD at the back of the room might come with the perception of needing the extra tools, which may have influenced student decision about using it.

Recommendations for practice

> *Our goal in using technologies should be to allocate to the learners the cognitive responsibility for the processing they do best while we allocate to the technology the processing that it does best.*
>
> *~Jonassen, Myers, & McKillop, (1996), p.96*

All learners benefit from UDL (Hitchcock et al., 2005; Rose & Meyer, 2002). Measuring students with a one-size-fits-all assessment does not respect the range of learners. Every classroom has diverse learners who have different strengths and needs depending on the situation. This research supports the premise that when students have access to alternative versions of the traditional print format of large-scale assessment, it may be a more satisfying experience for some of the students.

"Efforts to enhance the success of twenty-first-century learners will require a fundamental shift in thinking about, and responding to, learner differences" (Edyburn,

2011, p. 38). Incorporating the principles of UDL would be a way of addressing learner differences. When students write tests, for example, if they are all able to access assistive technology to provide alternatives to one representation, it can have a positive impact for all students. Whenever multiple representation can be incorporated into assessment, it provides choice for students; personalization that is not seen as an accommodation, but as an option to provide more opportunity for meeting potential. Sometimes students who know the content of a subject may actually perform poorly on the assessment if barriers to access are not recognized. This may jeopardize achievement as well as students perception about who they are as learners. A recommendation for practice is to ensure that students are not compromised when they write tests and exams. This means that teachers should account for learner differences, not by reducing standards, but by increasing the opportunities to "successfully access both content and learning in the curriculum" (Dolan et al, 2005, p. 7).

Recommendations for future research

> *In a world where we are very aware that understanding human behaviour requires knowledge of the complex interactions between both cultural and individual development, we should not be surprised to find that fostering human learning will require access solutions that are optimal interaction between what is universal and what is individual.*
>
> *~Rose, Hasselbring, Stahl & Zabala, (2005), p. 517*

While the researcher is confident that the study provides findings that address the research question, the study also generated more questions that need to be answered. Several recommendations for future research have arisen from this case study. "Whether either universally designed materials or AT in isolation can be helpful, it is at the intersection of the two that information access, and ultimately

learning, becomes most individualized and appropriate" (Rose, Hasselbring, et al., p. 514). This study has added to the small reservoir of growing research in the area of large-scale assessment and UDL. The findings from this study contribute to a repertoire of questions for further knowledge building about how UDL impacts student experience.

Questions to frame future research may include:

1. How do access to multiple representation through an audio format, such as audio CD or text to speech, and written format affect students' satisfaction with writing the grade twelve Social Studies diploma exams?
2. What are the implications of utilizing multiple representation on all grade nine provincial achievement tests throughout the province of Alberta?
3. What are secondary students perspectives about their experience with classes using UDL perspective for activities and assessments?
4. How does professional development on integration of technology change the design of instruction in high school classes?
5. How does targeted professional development disrupt traditional views about teaching?
6. How do schools make maximal use of limited resources through the lens of universal design?
7. What impact does access to multiple representation in different courses throughout the junior high years have upon choosing to utilize multiple representation for large-scale assessment?
8. How does fluid access to technology impact teacher perceptions for incorporating UDL into their classrooms?

9. How does fluid access to technology promote UDL?
10. What impact does access to multiple representation have on achievement results for grade nine students?
11. What policies are required to be able to fluidly incorporate digital textbooks into the repertoire of resource materials for all students?
12. How does technology supports impact engagement in learning?
13. What supports are most effective to support students' appropriate use of technology?
14. What are the perspectives of parents of secondary students about their children's motivation and engagement in school when UDL is employed through resources used in the classroom?

In conclusion, UDL offers a viable opportunity to address the needs of diverse learners in educational settings by fostering "solutions targeting limitations in the curriculum rather than limitation in the student" (Rose, Hasselbring, et al., 2005, p 510). Gaining insight into how students perceive the use of multiple representation on the grade nine provincial achievement tests contributes to the research about addressing individual student needs during large-scale assessment.

This study provides insight into the experience of a group of grade nine students and their teachers about being offered access to multiple representation as a way of increasing satisfaction in the process of writing provincial achievement tests. There are students who, like Joshua in the vignette at the beginning of Chapter one, are challenged going into large-scale assessment with its rigid one-size-fits-all for format and time. Multiple representation may have reduced Joshua's anxiety in approaching the test, especially since he already recognized that reading was his

challenge. He may have been more satisfied with taking the test with having aspects of his learning needs personalized. Perhaps Joshua would have felt that the test with multiple representation would reduce the barriers that typically impede his attempts to demonstrate his knowledge. Students in this study were attuned to the diversity in their classrooms and recognized that a student like Joshua could really benefit from multiple representation and fully supported the idea of having that choice. Students should not go into an exam feeling that the experience may be unsatisfactory because their learning needs are ignored which may reduce the likelihood that they can demonstrate their knowledge to their potential.

The teachers and school leaders in this study supported the concept that having multiple representation on large-scale assessment such as the provincial achievement test does provide a more satisfactory experience quite simply because it acknowledges diversity and provides choice to students. Multiple representation is not based upon meeting criteria or that one has to prove a global need across all subjects at all times but that students may have varying needs in different situations and therefore need universal access to supports. Students may choose to use multiple representation on demand for sections of the tests where they believe they are more challenged and then not use it for other sections where they feel more comfortable without any support. Having the choice was an important factor expressed by the majority of study participants.

Providing pervasive access to technologically enhanced learning and assessment needs to be further examined by stakeholders and researchers who believe that UDL makes a difference for student motivation, satisfaction and engagement. The potential is there to allow for all students in the province to be provided with

more universal accessibility on large-scale assessment while meeting the goal of the assessment, which is measuring student knowledge for subject content.

References

Alberta Education. (2011). *Action on curriculum*. Retrieved from: http://education.alberta.ca/department/ipr/curriculum.aspx

Alberta Education. (2011b). *Assistive technology for learning*. Retrieved from: http://education.alberta.ca/admin/technology/atl.aspx

Alberta Education. (2011c). *Diploma examinations*. Retrieved from: http://education.alberta.ca/admin/testing/diplomaexams/diplomabulletin.aspx

Alberta Education. (2010a). *Making a difference: meeting diverse learning needs with differentiated instruction.* Retrieved from: http://www.education.alberta.ca/teachers/resources/cross/making-a-difference.aspx

Alberta Education. (2010b). *Action on inclusion*. Retrieved from: http://education.alberta.ca/department/ipr/inclusion/about.aspx

Alberta Education. (2009a). *Inspiring education: a dialogue with Albertans*. Retrieved from: http://www.inspiringeducation.alberta.ca/LinkClick.aspx?fileticket=wqYRVMaWPH8%3d&tabid=124

Alberta Education. (2009b). *Setting the direction*. Retrieved from: http://education.alberta.ca/media/1082136/sc_settingthedirection_framework.pdf

Almond, P. & Karvonen, M. (2007). Accommodations for a K to 12 Standardized Assessment: Practical Implications for Policy. In C. Cahalan Laitusis & L.L. Cook, (Eds.), *Large-scale assessment and accommodations: what works?* (pp. 117-136), Arlington, VA: Council for Exceptional Children.

Almond, P., Winter, P., Cameto, R., Russell, M., Sato, E., Clarke-Midura, J., …Lazarus, S. (2010). Technology-enabled and universally designed assessment:

considering access in measuring the achievement of students with disabilities—a foundation for research. *Journal of Technology, Learning, and Assessment, 10*(5), 4-51.

Basham, J., Israel, M., Graden, J., Poth, R., & Winston, M. (2010). A comprehensive approach to rti: embedding universal design for learning and technology. *Learning Disability Quarterly*, 33(4), 243-255.

Beddow (2011). Accessibility theory to advance testing for all students. In M. Russell & M. Kavanaugh (Eds.), *Assessing students in the margin: challenges, strategies, and techniques* (pp.381-405). USA: Information Age Publishing.

Black, P., & D. Wiliam. (2006). The reliability of assessment. In J. Gardner (Ed.), *Assessment and learning* (pp.9–26). London: Sage.

Bolt, S.E. (2011). Factors to consider in providing appropriate test accommodations to individuals students with disabilities. In M. Russell & M. Kavanaugh (Eds.), *Assessing students in the margin: challenges, strategies, and techniques* (pp. 3-30). USA: Information Age Publishing.

Bransford, J., Barron, B., Pea, R. Meltzoff, A., Kuhl, P., Bell, P, …. Sabelli, N. (2006). Foundations and opportunities for an interdisciplinary science of learning. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences*, (pp. 19-34). Cambridge: Cambridge University Press.

Brinckerhoff, L. & Banerjee, M. (2007). Misconceptions regarding accommodations on high-stakes tests: recommendations for preparing disability documentation for test takes with learning disabilities. *Learning Disabilities Research & Practice, 22*(4), 246-255.

Burgstahler, S. & Cory, R. (2008). *Universal design in high education: from principles to practice.* Cambridge, MA: Harvard University Press.

Callahan, R.E. (1962). *Education and the Cult of Efficiency.* Chicago: Phoenix Books, University of Chicago Press.

Campbell, D. (2004). Assistive technology and universal instructional design: a postsecondary perspective. *Equity & Excellence in Education*, 37(2), 167-173.

Center for Applied Special Technology (CAST). (2012a). *About UDL*. Retrieved from: http://cast.org/udl/index.html

Center for Applied Special Technology (CAST). (2012b). *UDL Guidelines*. Retrieved from: http://www.cast.org/library/UDLguidelines/index.html

Christians, C.G. (2005). Ethics and politics in qualitative research. In N.K. Denzin & Y.S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed.) (pp. 139-164). Thousand Oaks, CA: SAGE Publications.

Chudowsky, N. & Pellegrino, J. (2003). Large-scale assessments that support learning: what will it take? *Theory into Practice, 42*, 75–83.

Collins, A. & Halversont, R. (2010). The second educational revolution: rethinking education in the age of technology. *Journal of Computer Assisted Learning, 26*(1), 18-27. doi: 10.1111/j.1365-2729.2009.00339.x

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

Crawford, L. & Tindal, G. (2007). A teacher's role in the implementation of assessment accommodations. In CC Laitusis & LL Cook (Eds.). *Large-Scale Assessment and Accommodations: What Works?* (pp.137-143). Arlington, VA: Council of Exceptional Children.

Creswell, J. (2009). *Research design: choosing among five approaches.* Thousand Oaks: Sage Publications.

Creswell, J. W., Slope, R., Plano Clark, V., & Green, D. (2006). How interpretative qualitative research extends mixed methods research. *Research in the Schools, 13*(1), 1-11.

Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process.* Thousand Oaks: Sage Publications.

Davies, A. & Williams, P. (1997). Accountability: issues, possibilities, and guiding questions for district wide assessment of student learning. *Phi Delta Kappa*, *79*(1), 76-79.

Denzin, N.K. (2005). Emancipatory discourses and the ethics and politics of interpretation. In N.K. Denzin & Y.S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed.) (pp.933-958). Thousand Oaks, CA: Sage Publications.

Dolan, R. & Hall. T. (2007). Developing accessible tests with universal design and digital technologies: ensuring we standardize the right things. In C.C. Laitusis & L.L. Cook (Eds.). *Large-Scale Assessment and Accommodations: What Works?* (pp. 95-111). Arlington, VA: Council of Exceptional Children.

Dolan, R., Hall, T., Banerjee, M., Chun, E., & Strangman, N. (2005). Applying principles of universal design to test delivery: the effect of computer-based read-aloud on test performance of high school students with learning disabilities. *Journal of Technology, Learning, and Assessment, 3*(7), 4-32.

Edyburn, D. (2006). Failure is not an option. *Learning & Leading with Technology, 34* (1), 20-23.

Edyburn, D. (2011). Harnessing the potential of technology to support the academic success of diverse students. *New Directions for Higher Education, 154*, 37-44, doi: 10.1002/he.432

Edyburn, D. (nd). Principles of universal design and the implications for policy initiatives. *UD & Policy*, Alberta Education. Retreived from: http://education.alberta.ca/media/938200/edyburnudlreport.pdf

Edyburn, D. (2007). Technology-enhanced reading performance: defining a research agenda. *Reading Research Quarterly, 42*(1), 146-152.

Edyburn, D. (2010). Would you recognize universal design for learning if you saw it? Ten propositions for new directions for the second decade of UDL. *Learning Disability Quarterly, 33*(1), 33-41.

Ezzy, D. (2010). Qualitative interviewing as an embodied emotional performance. *Qualitative Inquiry 16*(3), 163-170. doi:10.1177/1077800409351970

Feldman, E., Kim, J. & Elliott, S. (2011). The effects of accommodations on adolescents' self-efficacy and test performance. *The Journal of Special Education. 45*(2), 77-88. doi:10.1177/0022466909353791

Fischer, K.W. (2009). Building a scientific groundwork for learning and teaching. *Mind, Brain and Education, 3*(1), 3-16.

Fischer, K.W., Goswami, U., Geake, J. (2010). The future of educational neuroscience. *Mind, Brain and Education*, *4*(2), 68-80.

Friesen, S. (2009). Galileo educational network: creating, researching, and supporting 21st century learning. *Education Canada, 49*(5), 7-9.

Fullan, M., Hill, P. & Crevola, C. (2006). *Breakthrough.* Thousand Oaks, CA: Corwin Press, Sage Publications.

Gardner, H. (1983). *Frames of mind*. New York: Basic Books Inc.

Gardner, H. (1999). *Intelligence reframed: multiple intelligences for the 21st century*. New York: Basic Books Inc.

Goodson, I. (1992). On curriculum form: notes toward a theory of curriculum. *Sociology of Education, 65*(1), 66-75.

Haladyna, T. & Downing, S. (2004). Construct-irrelevant variance in high-stakes testing. *Educational Measurement: Issues and Practice, 23*(1), 17-27.

Hall, T., Strangman, N., & Meyer, A. (2003). *Differentiated instruction and implications for UDL implementation.* Wakefield, MA: National Center on Accessing the General Curriculum. Retrieved from: http://aim.cast.org/learn/historyarchive/backgroundpapers/differentiated...

Hall, T., Meyer, A., Rose, D.H. (2012). *Universal design for learning in the classroom: practical applications.* New York: Guilford Press.

Halquist, D. & Musanti, S. (2010). Critical incidents and reflection: turning points that challenge the researcher and create opportunities for knowing. *International Journal of Qualitative Studies in Education, 23*(4), 449-461. doi:10.1080/09518398.2010.492811

Hehir, T. (2007). Confronting ableism. *Educational Leadership, 64(5),* 8-14.

Hehir, T. (2005). *New directions in special education: eliminating ableism in policy and practice.* Cambridge, MA: Harvard Education Press.

Herman, J., Baker, E., & Linn, R.L. (2004). Accountability systems in support of student learning: moving to the next generation. *Association for Supervision and Curriculum Development*. Retrieved from: http://www.ascd.org/publications/newsletters/policy-priorities/winter08/num52/full/The-Case-for-Multiple-Measures.aspx

Hitchcock, C., Meyer, A., Rose, D., & Jackson, R. (2005). Equal access, participation, and progress in the general education curriculum. In Rose, D., Meyer, A., & Hitchcock, C., (Eds.). *The universally designed classroom: accessible curriculum and digital technologies* (pp.37-68). Cambridge, MA: Harvard Education Press.

Hitchcock, C. & Stahl, S. (2003). Assistive technology, universal design, universal design for learning: improved learning opportunities. *Journal of Special Education, 18*(4), 45-52.

Idler, E., Hudson, S., & Leventhal, H. (2008). The meanings of self ratings of health. In V. Plano-Clark & J. Creswell (Eds.), *The mixed method reader* (pp.393-410). Thousands Oaks, CA: Sage Publication.

Individuals with Disabilites Education Act, Pub.L, No. 105-17, 20. (1997). Retrieved from: http://www2.ed.gov/offices/OSERS/Policy/IDEA/the_law.html

Jacobsen, D.M. (2008). An educational technology vision of 21st century college classrooms. *MindShare Learning Report.* Retrieved from: http://www.mindsharelearning.com/report/sep_08/docs/Michele_Jacobsen_he_askaprofessor.pdf

Jackson, R., Harper, K., & Jackson, J. (2005). Teaching for accessibility: effective practices, classroom barriers. In D. Rose, A. Meyer & C. Hitchcock (Eds.), *The universally designed classroom: accessible curriculum and digital technologies* (pp. 125-147). Cambridge, MA: Harvard Education Press.

Januszewski, A. & Molenda, M. (2008). *Educational technology: a definition with commentary.* New York, NY: Lawrence Erlbaum Associates.

Jimenez, T., Graf, V. & Rose, E. (2007). Gaining access to general education: the promise of universal design for learning. *Issues in Teacher Education, 16*(2), 41-54.

Johnson, R.B., Onwuegbuzie, A.J. & Turner, L.A. (2007). Towards a definition of mixed methods research. *Journal of Mixed Methods Research 1*(2), 112-133. doi:10.1177/1558689806298224

Johnstone, C. J. (2003). *Improving validity of large-scale tests: Universal design and student performance* (Technical Report 37). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved http://education.umn.edu/NCEO/OnlinePubs/Technical37.htm

Johnstone, C. J., Thompson, S. J., Miller, N. A., & Thurlow, M. L. (2008). Universal design and multi-method approaches to item review. *Educational Measurement: Issues and Practice, 27*(1),25-36.

Ketterlin-Geller, L.R. (2005). Knowing what all students know: procedures for developing universal design for assessment. *Journal of Technology, Learning and Assessment, 4*(2), 1-25.

King-Sears, M. (2009). Universal design for learning: technology and pedagogy. *Learning Disability Quarterly, 32*(4), 199-201.

Kleinsasser, A. M. (2000). Researchers, reflexivity, and good data: writing to unlearn. *Theory Into Practice*, *39*(3), 155-162.

Lachat, M.A. (2003). Putting student performance data at the center of school reform: new expectations for student achievement and school accountability. In J. Dimartino, J. Clarke, & D. Wolk (Eds.), *Personalized Learning: preparing high school students to create their futures* (pp.211-221) Lanham: Scarecrow Press, Inc.

Lapinski, S., Gravel, J., & Rose, D.H. (2012). Tools for practice: the universal design for learning guidelines. In T. Hall, A. Meyer, & D.H. Rose, (Eds.). *Universal design for learning in the classroom: practical applications.* (pp. 9-24). New York: Guilford Press.

LeCompte, M. (2000). Analyzing qualitative data. *Theory Into Practice, 39* (3), 146-154.

Linn, R.L. (2000). Assessment and accountability. *Educational Researcher,* 29 (2), 14–16.

Lopes-Murphy, S. (2012). Universal design for learning: preparing secondary education teachers in training to increase academic accessibility of high school learners. *The Clearing House, 85,* 226-230. doi:10.1080/00098655.2012.693549

Luria, A.R. (1973). *The working brain*. New York, NY: Basic Books.

Mace, R, Hardie, G. & Place, J. (1996). *Accessible environments: toward universal design.* Raleigh, NC : Center for Universal Design.

Marshall, C. & Rossman, G. (2006). *Designing Qualitative Research.* Thousand Oaks: Sage Publishing.

Marino, M. (2009). Understanding how adolescents with reading difficulties utilize technology-based tools. *Exceptionality, 17*(2), 88-102. doi:10.1080/09362830902805848

McGuire, J. M., Scott, S. S., & Shaw, S. F. (2006). Universal design and its application in educational environments. *Remedial and Special Education, 27*(3), 166-175.

Messick, S. (1989). Meaning and values in test validation: the science and ethics of assessment. *Educational Researcher, 18*(2), 5-11.

Messinger-Willman, J. & Marino, M. (2010). Universal design for learning and assistive technology: leadership considerations for promoting inclusive education in today's secondary schools. *NASSP, 94*(1), 5-16. doi:10.1177/092636510371977

Meo, G. (2008). Curriculum planning for all learners: applying universal design for learning (UDL) to a high school reading comprehension program. *Preventing School Failure, 52*(2), 21-30.

Meo, G. (2006). Frequent questions about universal design for learning. In D.H. Rose & A. Meyer. (Eds.). *A practical reader in universal design for learning*. Cambridge, MA: Harvard Education Press.

Meyer, A. & O'Neill, L.M. (2000). Beyond access: universal design for learning. *The Exceptional Parent*, 30(3), 59-60.

Meyer, A. & Rose, D.H. (2005). The future in the margins: the role of technology and disability in educational reform. In D. Rose, A. Meyer & C. Hitchcock (Eds.), *The universally designed classroom: accessible curriculum and digital technologies* (pp. 13-35). Cambridge, MA: Harvard Education Press.

Morra, T. & Reynolds, J. (2010). Universal design for learning: application for technology-enhanced learning. *The Journal of the Virginia Community Colleges*, 15(1), 43-51.

Nagy, P. (2000). The three roles of assessment: Gatekeeping, accountability, and instructional diagnosis. *Canadian Journal of Education, 25*, 262-279.

Onwuegbuzie, A.J. & Johnson, R.B. (2008). The validity issue in mixed research. In V. Plano-Clark & J.W. Creswell (Eds.), *Mixed methods reader* (pp. 273-288). Thousand Oaks, CA: Sage Publications.

Parette, H. P., & Peterson-Karlan, G. (2007). Facilitating student achievement with assistive technology. *Education and Training in Developmental Disabilities, 42*(4), 387-397.

Pellegrino, J. & Quellmalz, E. (2010). Perspectives on the integration of technology and assessment. *Journal of Research on Technology in Education, 43*(2), 119-134.

Pinar, W., Reynolds, W., Slattery, P. & Taubman, P. (2008). *Understanding curriculum.* New York: Peter Lang Publishing.

Pisha, B. & Coyne, P. (2001). Smart from the start. *Remedial and Special Education, 22*(4), 197-203.

Pisha, B. & Stahl, S. (2005). The promise of new learning environments for students with disabilities. *Intervention in School and Clinic, 41*(2), 67-75.

Preissle, J. (2006). Envisioning qualitative inquiry: a view across four decades. *International Journal of Qualitative Studies in Education, 19*(6), 685-695.

Quintana C., Reiser, B., Davis, E., Krajcik, J., Fretz, E., Golan, R., Kyza, E., Edelson, D., & Soloway, E. (2004). A Scaffolding Design Framework for Software to Support Science Inquiry. *The Journal of the Learning Sciences 13*(3), 337-386.

Roberts, K., Park, H., Brown, S. & Cook, B. (2011). Universal design for instruction in Postsecondary Education: a systematic review of empirically based articles. *Journal of Post Secondary Education and Disability, 24*(1), 5-15.

Rose, D.H. (2011, July). UDL Summer Institute lectures presented at Harvard University.

Rose, D.H. (2000). Universal design for learning. *Journal of Special Education Technology, 15*(1), 67-70.

Rose, D.H. & Dalton, B. (2009). Learning to read in the digital age. *Mind, Brain and Education, 3*(2), 74-83.

Rose, D.H. & Dolan, R.P. (2006). Implications of universal design for learning for classroom assessment. In D.H. Rose. & A. Meyer, A., (Eds.), *A practical reader in universal design for learning,* (pp.73-83). Cambridge, MA: Harvard Education Press.

Rose, D.H., Gravel, J.W. & Domings, Y.M. (2009). UDL unplugged: the role of technology in UDL. *National Center on Universal Design for Learning*. Retrieved from: http://www.udlcenter.org/sites/udlcenter.org/files/notech_final2.pdf

Rose, D.H. & Gravel, J.W. (2012). Curricular opportunities in the digital age. *Students at the Center: Teaching and Learning in the Era of the Common Core, a Jobs for the Future Project.* Retrieved from: http://www.studentsatthecenter.org/sites/scl.dl-dev.com/files/Curricular%20Opportunities%20Digital%20Age.pdf

Rose, D.H., Hasselbring, T.S., Stahl, S. & Zabala, J. (2005). Assistive technology and universal design for learning: two sides of the same coin. In D. Edyburn, K. Higgins & R. Boone (Eds.), *Handbook of special education technology research and practice* (pp. 507-518). Whitefish Bay, WI: Knowledge by Design.

Rose, D.H. & Meyer, A. (2002). *Teaching every student in the digital age: universal design for learning.* Alexandria, VA: ASCD.

Rose, D.H., Meyer, A., & Hitchcock, C. (Eds.). (2005). *The universally designed classroom: accessible curriculum and digital technologies.* Cambridge, MA: Harvard Education Press.

Salend, S. (2009). Using technology to create and administer accessible tests. *Teaching Exceptional Children, 41*(3), 40-51.

Sawyer, R.K. (Ed.). (2006). *The Cambridge handbook of the learning sciences*. Cambridge: Cambridge University Press.

Schelly, C., Davies, P., & Spooner, C. (2011). Student perceptions of faculty implementation of universal design for learning. *Journal of Postsecondary Education and Disability, 24*(1), 17-30.

Silver-Pacuilla, H. (2006). *Moving toward solutions: Assistive & learning technology for all students.* Washington, DC: National Center for Technology Innovation. Retrieved from: http://www.nationaltechcenter.org/

Spooner, F., Baker, J. N., Harris, A. A., Ahlgrim-Delzell, L., & Browder, D. M. (2007). Effects of training in universal design for learning on lesson plan development. *Remedial and Special Education, 28*(2), 108-116.

Stahl, S. (2003). Universal design for learning. *Journal of Special Education Technology, 18*(2), 65-67.

Stake, R.E. (2006). *Multiple case study analysis*. New York: Guilford Press.

Stake, R.E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.

Thompson, S. J., Johnstone, C. J., & Thurlow, M. L. (2002). *Universal design applied to large-scale assessments* (Synthesis Report 44). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved April 22, 2011, from http://education.umn.edu/NCEO/OnlinePubs/Synthesis44.html

Thurlow, M. (2010). Steps toward creating fully accessible reading assessments. *Applied Measurement in Education, 23*(2), 88-102. doi:10.1080/08957341003673765

Thurlow, M., Johnstone, C., & Ketterlin-Geller, L. (2008). Universal design of assessment. In Burgstahler, S. & Cory, R., (Eds.). *Universal design in higher education: from principles to practice,* (p.73-81). Cambridge, MA: Harvard Education Press.

Tomlinson, C. (2001). *How to differentiate instruction in mixed ability classrooms.* Alexandria, VA: ASCD.

Tomlinson, C., Brighton, C., Hertberg, H., Callahan, C., Moon, T., Brimijoin, L.,…& Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: a review of the literature. *Journal for the Education of the Gifted, 27*(2/3), 119-145.

Tomlinson, C., Brimijoin, K., & Narvaez, L. (2008). *The differentiated school: making revolutionary changes in teaching and learning.* Alexandria, VA: ASCD.

Tucker, B. (2009). *Beyond the bubble: technology and the future of student assessment*. Education Sector Reports.

Van Duzer, Eric. (2006). *Overcoming the limitations of the factory system of education*. Online submission. Retrieved from: http://www.eric.ed.gov/ERICWebPortal/search/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED490530&ERICExtSearch_SearchType_0=no&accno=ED490530

Vogler, K. E. & Virtue, D. (2007). "Just the facts, ma'am": teaching social studies in the era of standards and high-stakes testing. *Social Studies* 98(2): 54–58.

Vreeburg Izzo, M., Murray, A., & Novak, J. (2008). The faculty perspective on universal design for learning. *Journal of Postsecondary Education and Disability, 21*(2), 60-71.

Vygotsky, L.S. (1978). *Mind in society: the development of higher psychological processes.* USA: Harvard College.

Worden, J.M., Hinton, C., & Fischer, K.W. (2011). What does the brain have to do with learning? *Kappan Magazine*, 92(8), 8-13.

Yin, R.K. (2009). *Case study research: design and methods*. 4th edition. Thousand Oaks, CA: Sage Publications.

Yin, R.K. (2003). *Case study research: design and methods*. 3rd edition. Thousand Oaks, CA: Sage Publications.

APPENDIX A—Pre and Post Surveys

Pre Survey (online)

Thank you for taking the time to complete this 12-question survey. It will take approximately 5-10 minutes to complete. This online survey is anonymous. This survey does not have any known risks for participants. In this survey you will be asked to give information about your interest in using text to speech or audio CD during grade 9 provincial achievement test writing for social studies and/or mathematics. You will also be asked about your use of technology at home and at school.

How frequently did you use technology this semester to support your learning in day-to-day classroom activities and assignments at school?

- never
- less than one hour a day
- between 1 to 2 hours a day
- more than 2 hours a day

How frequently do you use technology at home on a daily basis to research things that are of interest to you?

- hardly ever use computers at home
- at least once a week
- at least 2 to 3 times a week
- almost every day
- daily

How frequently did you use technology in testing situations?

- never use it in tests
- less than once a month
- a couple of times a month
- weekly

How interested are you in using technology such as digital text, text to speech, audio CDs to better suit your learning preferences during tests (ie: unit finals, mid terms or final exams)?

- not interested
- somewhat interested
- interested
- very Interested

I believe that having access to digital text with text to speech software or audio CD will improve my performance on tests and exams.

- strongly Agree
- agree
- neutral
- disagree
- strongly Disagree

Having access to digital text with text to speech or audio CD will likely be more satisfying than just having the traditional pen and paper.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I consider myself to be a strong reader.

- strongly Agree
- agree
- neutral
- disagree
- strongly disagree

When I write exams I believe I lose marks because I have misread questions.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I believe my marks would be higher on tests and exams if I could read as well as listen to the questions and instructions.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

Are you male or female?

- female
- male

Are you currently on an Individual Program Plan for diagnosed learning needs such as a learning disability, visual loss, hearing loss or physical disability?

- yes
- no

If yes, please indicate the reason for your IPP_____
_____

Which courses are you taking this semester? (Check all that apply)

- mathematics
- social studies
- language arts
- science

Thank you for participating in this survey.

POST Survey (online)

Thank you for taking the time to complete this 15-question survey. It will take approximately 5-10 minutes to complete. This online survey is anonymous. This survey does not have any known risks for participants.

In this survey you will be asked to give information about your experience and interest in using digital text with text to speech or audio CD during the provincial achievement test writing for social studies and/or mathematics as well as your use of technology at home and at school.

How frequently did you use technology this semester to support your learning in day to day classroom activities and assignments at school?

- never
- less than one hour a day
- between 1 to 2 hours a day
- more than 2 hours a day

How frequently do you use technology at home on a daily basis to research things that are of interest to you?

- hardly ever use computers at home
- at least once a week
- at least two to three times a week
- almost every day
- daily

Not including social studies or mathematics, how frequently did you use technology in testing situations?

- never use it in tests
- less than once a month
- a couple of times a month
- weekly

How interested are you in using technology such as digital text with text to speech or audio CD to better suit your learning preferences during tests such as unit finals, mid terms or final exams?

- not interested
- somewhat interested
- interested
- very interested

How would you rate the level of difficulty using text to speech or audio CD during your provincial achievement exam?

- no difficulties at all
- not difficult
- average
- moderately difficult
- very difficult

My experience using the digital text with text to speech software or audio CD on the provincial achievement test was positive.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I believe having access to digital text with text to speech software or audio CD helped me to perform better during the writing of the provincial achievement testing.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I was very satisfied with having access to digital text with text to speech or audio CD during the provincial achievement testing.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I would be interested in accessing text to speech or audio CD for future tests and exam writing.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

When I write exams without using text to speech or audio CD, I sometimes lose marks because I misread questions.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

I consider myself to be a strong reader.

- strongly agree
- agree
- neutral
- disagree
- strongly disagree

During the exam I used the text to speech or audio CD

- 100% of the time
- between 75% and 100% of the time
- between 50% and 75% of the time
- between 25% and 50% of the time
- less than 25% of the time
- not at all

Are you male or female?

- female
- male

Are you currently on an Individual Program Plan for a diagnosed learning need such as a learning disability, visual loss, hearing loss or physical disability?

- yes
- no

If yes, please indicate the reason for your Individual Program Plan_____
_____

Which courses did you take this past semester?

- mathematics
- social studies
- language arts
- science

What was your school assigned mark for Math before the provincial achievement test?

- below 40%
- between 40% and 50%
- between 50% and 60%
- between 60% and70%
- between 70% and 80%
- above 80%
- I did not take mathematics this semester

What was your school assigned mark for social studies before the provincial achievement test?

- below 40%
- between 40% and 50%
- between 50% and 60%
- between 60% and70%
- between 70% and 80%
- above 80%
- I did not take Social Studies this semester.

Thank you for participating in this survey.

APPENDIX B—Letter of Introduction

UNIVERSITY OF CALGARY

December 12, 2011

Dear Parent and Student,

I am a doctoral candidate in Educational Technology, Faculty of Education at the University of Calgary. I have been studying how educational technology can influence educational practices through the principles of universal design for learning. Universal design for learning (UDL) is a theoretical perspective that considers the multiple ways students can access learning concepts at school such as through traditional text, audio text and multimedia. UDL considers the multiple ways that students engage in learning and what motivates them. UDL also considers the multiple ways that students can demonstrate what they know.

For my research I am focusing on a study **to build understanding about student satisfaction with having their personal learning needs addressed, especially on standardized exams, through universal access to digital text with text to speech and/or audio CD.** Students will have the opportunity to use text to speech or audio CD or digital audio file by being instructed on how to use it and then trying it on at least two tests before they write the provincial achievement test. Students can choose which mode or modes work best for them. All the students in first semester grade 9 social studies and/or mathematics classes are invited to participate in the study to explore student satisfaction with access to digital text with text to speech or audio CD for the provincial achievement test.

In order for students to participate, parents must give permission for their daughter/son to be a part of the study. Enclosed is a parent informed consent form. Please read through the consent form carefully. It is my hope that you will agree to have your son/daughter participate in this research to explore student satisfaction with having access to digital text with text to speech or audio CD for writing the provincial achievement test. This research does not expose your son or daughter to any risks beyond those encountered in everyday life.

Should you and your son/daughter be interested in participating in this study, **please sign the attached consent form and return to the school office by Friday, December 16, 2011.** I have provided you with an extra copy of the consent form for your records. Please send the form in the envelope provided. There is an envelope for the parent consent and a separate envelope for student consent. If you are not interested could you return the forms in the enclosed with a line drawn through the consent portion.

Be assured that your daughter/son's participation, nonparticipation or withdrawal will have no effect whatsoever on student grades. I do not have any authority over your child(ren) or your child(ren)'s teacher. Should your son/daughter join the study, you or your son/daughter may change your minds at a later date if either of you do not wish to continue.

You may also contact me personally at ejhickey@ucalgary.ca or phone 403-875-1910 or my supervisor, Dr. Michele Jacobsen at dmjacobs@ucalgary.ca or phone 403-220-4123.

Sincerely,

Evelyn Hickey
Doctoral Candidate, University of Calgary

APPENDIX C—Consent Forms

Project Title: Dismantling barriers to provincial achievement testing through utilizing multiple representation.

Investigator: Evelyn Hickey, Doctoral Candidate, Educational Technology

Supervisor: Dr. Michele Jacobsen

Research Approval: The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study

Research Consent Form - Use of Parent Comments in Phone Conversations

As indicated in the consent form you signed for your son or daughter to participate in the research project for the grade nine students, this research study has been approved by the University of Calgary Conjoint Faculties Research Ethics Board and your school district. Permission to conduct this research utilizing the grade 9 social studies and mathematics provincial achievement tests has been given by the Director of Alberta Education Learner Assessment. Your school principal has also agreed for the research to take place.

Purpose of the Study:
The research seeks to explore student satisfaction with having access to digital text with text to speech or audio CD for writing the multiple choice section of the grade 9 social studies and mathematics provincial achievement tests as an avenue toward more personalization of learning thus reducing potential barriers.

Study Procedure:
All students taking grade 9 social studies and/or mathematics at your local school in the first semester have been given the opportunity to participate in this study. Students were given an online survey at the beginning of the process, which took about ten minutes to complete. After completing the social studies and/or mathematics provincial achievement test(s), all students participating in the research will be given an online post survey, which will take about ten minutes to complete. A random sample of students will be invited to participate in a confidential one-on-one interview to give more detailed information about the experience of having access to digital text with text to speech and/or audio CD. This interview is anticipated to take about forty-five minutes to sixty minutes. Parents can be given access to the survey items as well as copies of the interview questions that will be used. Parents will not be given student responses to survey, which will be anonymous. Parents will also not be given access to student responses to interviews, which will be confidential. In order to facilitate the online survey, the researcher will require the parent and/or student contact information, which will remain confidential and used only for this research. The interview will be audio or digitally recorded and then transcribed. *In some situations parents may provide particular insight through an informal phone conversation in relation to the study. In order to use this information, a parent must give permission for these comments to be incorporated into research notes. Only those comments associated directly to the study will be used.*

Risks:
There are no known risks associated with your participation through the informal comments made. Any information will be confidential. You can decline and your comments will not be used. This will not affect the relationship with the researcher, the school or the classroom

teacher. Information collected up to the point of withdrawal will be used in the study. Your participation in this study is absolutely voluntary.

Signatures/Consent:
Your signature on this form indicates that you understand that I would like to use your comments from our informal phone conversation to provide further insight during the analysis and writing up of the results and that you are giving permission for these informal comments to be used.

This signature does not waive your legal rights nor release the researcher, sponsors or involved institutions from their legal and professional responsibilities.

Student Name: (please print) _____

Parent/Guardian Name: (please print) _____

Parent/Guardian email: _____

Parent phone number: _____

Parent Signature: _____Date: _____

Researcher Signature: _____Date: _____

Questions/Concern
Should you have any questions about the research or any related matters, please contact:

Evelyn Hickey, Doctoral Candidate
Educational Technology, Graduate Programs, Faculty of Education
ejhickey@ucalgary.ca, 403-875-1910

Doctoral Supervisor: Dr. D. Michele Jacobsen
Associate Professor, Faculty of Education, University of Calgary
Chair, Educational Studies in Language, Culture and Technology
dmjacobs@ucalgary.ca, 403.220.4123

If you wish to make a comment or complaint regarding your treatment as a participant in this study, you are invited to contact the Senior Ethics Resource Officer at
rburrows@ucalgary.ca, 403-220-3782

UNIVERSITY OF CALGARY

Research Project Title: Dismantling barriers to provincial achievement testing through utilizing multiple representation.

Investigator: Evelyn Hickey, Doctoral Candidate, Educational Technology

Supervisor: Dr. Michele Jacobsen

Research Approval: The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study

Research Consent Form - Parent

Your daughter/son is invited to take part in a research study. Before giving permission to participate it is important that you are fully informed about the research including the purpose, what your son/daughter will be asked to do, what types of information will be collected, what will happen to the information provided, and potential risks. Please feel free to ask the researcher any extra questions of clarification.

This research study has been approved by the University of Calgary Conjoint Faculties Research Ethics Board and your school district. Permission to conduct this research utilizing the grade 9 social studies and mathematics provincial achievement tests has been given by the Director of Alberta Education Learner Assessment. Your school principal has also agreed for the research to take place.

Purpose of the Study:
The research seeks to explore student satisfaction with having access to digital text with text to speech or audio CD for writing the multiple choice section of the grade 9 social studies and mathematics provincial achievement tests as an avenue toward more personalization of learning thus reducing potential barriers.

Study Procedure:
All students taking grade 9 social studies and/or mathematics at your high school in the first semester will be given the opportunity to participate in this study. Students will be given an online survey at the beginning of the process, which would take about ten minutes to complete. Students will also be provided instruction and adequate time to use digital text with text to speech, digital audio file or audio CD in at least two trial situations before having access to use it on the provincial achievement test. The instruction and practice will take about twenty to forty minutes prior to using it on the first test; this practice will be a part of normal learning activities in the classroom. These tests will not be addition to classroom tests, but will be a test that all students in the classroom need to write as part of their regular assessment (ie, unit exam or a quiz). After completing the social studies and/or mathematics provincial achievement test(s), all students participating in the research will be given an online post survey, which will take about ten minutes to complete. A random sample of students will be invited to participate in a confidential one-on-one interview to give more detailed information about the experience of having access to digital text with text to speech and/or audio CD. This interview is anticipated to take about forty-five minutes to sixty minutes. Parents will be given a copy of the survey items as well as copies of the interview questions that will be used. Parents will not be given student responses to survey, which will be anonymous. Parents will also not be given access student responses to interviews, which will be confidential. In order to facilitate the online survey, the researcher will require the parent and/or student email contact information, which will remain confidential and used only for this research. The interview will be audio or digitally recorded and then transcribed.

Use of collected information:
The main use of the information collected will be used to inform a project required for the researcher to complete a Doctor of Education. The data will be stored in a locked filing cabinet or on the researcher's computer during the research project. It will be archived indefinitely at the University of Calgary through my supervisor's confidential storage process.

This research project involves the collection of unencrypted data via electronic means (e.g. email, Skype, etc.); as such your information may be seen by others, and may also be subject to US laws including the USA Patriot Act.

This research will explore students' perceptions and experiences with utilizing technology. It will also consider students' experience with having access to digital text with text to speech or audio CD for exam situations. This research may provide insight about whether this access is helpful with better meeting personal learning needs of students. The survey sections of this research will be anonymous as well as confidential. The interview section will be confidential with no personal identifying factors collected. The researcher will preserve confidentiality by assigning pseudonyms for participants' comments during the interview stage that may be used in documents. Information from this research will be used solely for the purpose of this study and any publications that may result from this study. A final copy of the research report will be provided to the school board superintendent and assistant superintendent, the school principal, Alberta Education, University of Calgary and the researcher's supervisory committee.

Risks:
There are no known risks associated with your son/daughter's participation in this study. Your daughter/son may withdraw from the study at any point while the study is taking place without giving a reason. This will not affect the relationship you have with the researcher, the school or the classroom teacher. Information collected up to the point of withdrawal will be used in the study. Your child's participation in this study is absolutely voluntary; participation, nonparticipation or withdrawal will have no affect whatsoever on student grades.

The online survey is being administered by QuestionPro(c), an American software company. As such, your responses are subject to U.S. laws, including the USA Patriot Act. The risks associated with participation are minimal, however, and similar to those associated with many e-mail programs, such as Hotmail(c) and social utilities spaces, such as Facebook(c) and MySpace(c)."

Signatures/Consent:
Your signature on this form indicates that you understand to your satisfaction the information provided about your daughter/son's participation and agree that your daughter/son may participate in this research. You understand that participation is voluntary and that your daughter/son is free to withdraw at any time.

This signature does not waive your legal rights nor release the researcher, sponsors or involved institutions from their legal and professional responsibilities.

Student Name: (please print) _____

Parent/Guardian Name: (please print) _____

Parent/Guardian email: _____

Parent/Guardian Signature: _____Date: _____

Researcher Signature: _____Date: _____

Questions/Concern
Should you have any questions about the research or any related matters, please contact:

Evelyn Hickey, Doctoral Candidate
Educational Technology, Graduate Programs, Faculty of Education
ejhickey@ucalgary.ca, 403-875-1910

Doctoral Supervisor: Dr. D. Michele Jacobsen
Associate Professor, Faculty of Education, University of Calgary
Chair, Educational Studies in Language, Culture and Technology
dmjacobs@ucalgary.ca, 403.220.4123

If you wish to make a comment or complaint regarding your treatment as a participant in this study, you are invited to contact the Senior Ethics Resource Officer at
rburrows@ucalgary.ca, 403-220-3782

UNIVERSITY OF CALGARY

Research Project Title: Dismantling barriers to provincial achievement testing through utilizing multiple representation.

Investigator: Evelyn Hickey, Doctoral Candidate, Educational Technology

Supervisor: Dr. Michele Jacobsen

Research Consent Form - Student

As you are aware your class is invited to take part in a research study. Your parents/guardians need to consent in order for you to participate. If your parents consent, then you need to consent yourself. Your consent is strictly confidential. Your parents, your teachers and your school will not know whether you have volunteered to participate or not.

As part of this research you are invited to provide your thoughts about your satisfaction with having your learning needs met through using multiple modes such as written, audio CD version or digital version of the provincial achievement test in mathematics and/or social studies. These different modes are considered the universal design principle of multiple representation, which means that you have access to different ways of understanding and using the information. Before giving permission to participate it is important that you are fully informed about the research including the purpose, what you will be asked to do, what types of information will be collected, what will happen to the information provided, and potential risks. Please feel free to ask the researcher any extra questions of clarification.

This research study has been approved by the University of Calgary, your school district and your school.

Purpose of the Study:
The main purpose of collected data is to inform a university project. The research seeks to explore student satisfaction with having access to digital text with text to speech and/or audio CD for writing the multiple choice section of the grade 9 provincial achievement testing for social studies and/or mathematics as an avenue toward more personalization of learning.

Study Procedure:
All students taking social studies and/or mathematics at your school in the first semester will be invited to participate in this study. Students will be given a survey at the beginning of the process, which would take about ten minutes to complete. They will also be provided instruction and time to use digital text with text to speech or audio CD prior to using it on the provincial achievement test in at least two testing situations. This instruction and practice will take about twenty to forty minutes. These tests will not be in addition to classroom tests, but will be a test that all students in the classroom need to write as part of their regular assessment (ie, unit exam or quiz). At the time, students will have access to digital text with text to speech or audio CD while writing. After completing the provincial achievement tests, all students participating in the research will be given a post survey, which will take about ten minutes to complete. A random sample of students will be invited to participate in a confidential one-on-one interview to give more detailed information about the experience of having access to digital text with text to speech. This interview is anticipated to take about forty-five minutes to sixty minutes. Those selected for the interview can participate in a private place at school or by phone or by Skype. Parents will be given a copy of the surveys as well as copies of the interview questions but not student answers to the survey or interview.

Use of collected information:
The information collected from the student surveys and interviews may provide information about whether using audio CD and/or digital text along with the written form is helpful with better meeting personal learning needs of students. The interview section will be confidential with no personal identifying factors collected. The researcher will protect your confidentiality by assigning different names for student comments during the interview stage that may be used in documents. Information from this research will be used only for the purpose of this study and any publications that may result from this study. The data will be stored in a secured locked filing cabinet or on the researcher's computer. The final report will be given to the school board superintendent and assistant superintendent, the school principal, Alberta Education and the University of Calgary.

Risks:
There are no known risks associated with your participation in this study. Your participation in this study is absolutely voluntary. Whether you choose to participate or not will not have any affect whatsoever on your relationship with your teacher or your school. This research does not have any affect on your grades.

Signatures/Consent:
Your signature on this form indicates that you understand the information provided about this study and agree that you want to volunteer to participate in the study. You have the right to change your mind about participating at any point and withdraw from it. Remember your participating in the interview is voluntary.

This signature does not waive your legal rights nor release the researcher, sponsors or involved institutions from their legal and professional responsibilities.

Student Name: (please print) _____

Signature: _____Date: _____

Researcher Signature: _____Date: _____

Questions/Concern
Should you have any questions about the research or any related matters, please contact:

Evelyn Hickey, Doctoral Candidate
Educational Technology, Graduate Programs, Faculty of Education
ejhickey@ucalgary.ca, 403-875-1910

Doctoral Supervisor: Dr. D. Michele Jacobsen
Associate Professor, Faculty of Education, University of Calgary
Chair, Educational Studies in Language, Culture and Technology
dmjacobs@ucalgary.ca, 403.220.4123

If you wish to make a comment or complaint regarding your treatment as a participant in this study, you are invited to contact the Senior Ethics Resource officer at rburrows@ucalgary.ca, 403-220-3782

UNIVERSITY OF CALGARY

Research Project Title: Dismantling barriers to provincial achievement testing through utilizing multiple representation.

Investigator: Evelyn Hickey, Doctoral Candidate, Educational Technology

Supervisor: Dr. Michele Jacobsen

Research Approval: The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study

Research Consent Form - Teacher

As you are aware your class is invited to take part in a research study and students will participate based upon informed consent from each of their parents. Collection and organization of consent forms is the researcher's responsibility. As part of this process you are invited to participate in a one-on-one interview to discuss your ideas about the universal design principle of multiple representation. Before giving permission to participate it is important that you are fully informed about the research including the purpose, what you will be asked to do, what types of information will be collected, what will happen to the information provided, and potential risks. Please feel free to ask the researcher any extra questions of clarification. Individual students in your class will also need parental permission via an informed consent form in order to participate. This will be the responsibility of the researcher to collect.

This research study has been approved by the University of Calgary Conjoint Faculties Research Ethics Board and your school district. Permission to conduct this research utilizing the grade 9 social studies and mathematics provincial achievement test has been given by the Director of Alberta Education Learner Assessment. Your school principal has agreed for this research to take place.

Purpose of the Study:
The research seeks to explore student satisfaction with having access to digital text with text to speech and/or audio CD for writing the multiple choice section of the grade 9 provincial achievement testing for social studies and/or mathematics as an avenue toward more personalization of learning.

Study Procedure:
All students taking grade 9 social studies and/or mathematics at your high school in the first semester will be invited to participate in this study. Students will be given a survey at the beginning of the process, which would take about ten minutes to complete. They will also be provided instruction and time to use digital text with text to speech and/or audio CD prior to using it on the provincial achievement test in at least two testing situations. This instruction and practice will take about twenty to forty minutes. These tests will not be in addition to classroom tests, but will be a test that all students in the classroom need to write as part of their regular assessment (ie, unit exam or quiz). At the time, students will have access to digital text with text to speech or audio CD while writing. After completing the provincial achievement tests, all students participating in the research will be given a post survey, which will take about ten minutes to complete. A random sample of students will be invited to participate in a confidential one-on-one interview to give more detailed information about the experience of having access to digital text with text to speech. This interview is anticipated to

take about forty-five minutes to sixty minutes. Parents will be given a copy of the surveys as well as copies of the interview questions but not student answers to the survey or interview.

Teachers will be invited to participate in a one-on-one interview to discuss their perceptions about the process.

Use of collected information:
The main use of the data will be to inform an Ed.D project. The information collected from teacher interviews will be used allow for a deeper analysis of the data by giving a different perspective. It may provide insight about whether this access is helpful with better meeting personal learning needs of students. The interview section will be confidential with no personal identifying factors collected. The researcher will preserve confidentiality by assigning pseudonyms for participants' comments during the interview stage that may be used in documents. Due to the nature of recruitment and the limited size of the participant sample, your identity as a participant in this study will likely be widely recognized by school administrators, staff and students at your school. Information from this research will be used solely for the purpose of this study and any publications that may result from this study. The data will be stored in a secured locked filing cabinet or on the researcher's computer. After completion of the research project, the data will be archived indefinitely at the University of Calgary but only the researcher and the researcher's supervisors will have access. The final report, not raw data, will be distributed to the school board superintendent and assistant superintendent, the school principal, Alberta Education, the University of Calgary and the researcher's supervisory committee.

Risks:
There are no known risks associated with your participation in this study. Your participation in this study is absolutely voluntary; participation, nonparticipation or withdrawal will have no affect whatsoever on your professional relationship with your school or school division. Your confidentiality may be negatively affected by the low number of potential teacher participants; despite the researcher's efforts, therefore, the fact of your participation may be easily recognized or inferred by your colleagues or supervisors.

Signatures/Consent:
Your signature on this form indicates that you understand to your satisfaction the information provided about this study and agree that you will participate in the study. You have the right to change your mind about participating at any point and withdraw from it. Remember your participating in the interview is voluntary.

This signature does not waive your legal rights nor release the researcher, sponsors or involved institutions from their legal and professional responsibilities.

Name: (please print) _____

Signature: _____Date: _____

Researcher Signature: _____Date: _____

Questions/Concern
Should you have any questions about the research or any related matters, please contact:

Evelyn Hickey, Doctoral Candidate
Educational Technology, Graduate Programs, Faculty of Education
ejhickey@ucalgary.ca, 403-875-1910

Doctoral Supervisor: Dr. D. Michele Jacobsen
Associate Professor, Faculty of Education, University of Calgary
Chair, Educational Studies in Language, Culture and Technology
dmjacobs@ucalgary.ca, 403.220.4123

If you wish to make a comment or complaint regarding your treatment as a participant in this study, you are invited to contact the Senior Ethics Resource officer at rburrows@ucalgary.ca , 403-220-3782

APPENDIX D—Student and Teacher Interview Questions

Interview Questions for Student

As we go through the interview, I want you to remember that everything you say is confidential. You will not be personally identified or associated with anything you say. Any quotes that I use in this research report will be anonymous. During the interview, please reflect on yourself as a student and what you know about how you learn best, the celebrations of your learning, the frustrations that you may have experienced and your use of technology. Consider this a conversation. Everything that you have to say is valuable to helping create understanding of you and other students in terms of considering your learning styles, preferences or needs.

Do you have any questions for me before we begin the interview?

Who are you?

1. Describe one of your successes as a student in the past year.

2. What are your strengths as a student?

3. Describe a learning environment that really engages you because it supports your learning style, preference or needs.

4. Knowing that all students have particular strengths and weaknesses, describe what you find difficult in activities, assignments or exam writing.

5. Describe what you find less difficult in activities, assignments or exam writing?

6. Describe a learning environment/experience that frustrates you.

Technology Use

1. Describe your use of technology in your life outside of school including the type of hardware (devices) and software that you use.

2. Describe your use of technology at school including the hardware and software that you use.

3. Describe changes you would like to see for technology use at school.

Exam Writing

1. Describe any concerns you may have when you go into an exam that is heavily weighted such as a midterm or a final exam. What supports do you think would help you in that situation?

2. Given that there is an expectation for grade 9 students to participate in provincial achievement tests, describe your ideal exam writing environment if you had any say over how it was set up.

3. Describe your experience with having access to text to speech or audio CD for tests, quizzes and the provincial achievement testing.

4. In terms of addressing your learning style, preference or needs as a student, what recommendation would you have for the people who develop diploma exams?

Participation in the Study

1. Describe what you have learned from participating in this research study.

2. Describe what you think is the purpose of the study.

3. What advice would you have for another student who may be provided with the option of using text to speech or audio CDs for an exam?

Do you have any other comments you would like to share or questions for me about the research?

Interview Questions for Teachers

As we go through the interview I want you to remember that everything you say is confidential. You will not be personally identified or associated with anything you say. Any quotes that I use in the research report will be anonymous. Reflect on your students and what you know about how they learn and the influence of technology. Consider this a conversation.

Do you have any questions for me before we begin the interview?

1. Briefly describe your teaching experience.

2. Describe your understanding of universal design for learning.

3. Describe how you have used technology to provide multiple means of representing concepts in your teaching.

4. Describe the challenges for integrating technology such as digital text or audio versions of text into assessment at your school.

5. Describe how your students have used technology to support their individual learning preferences.

6. Describe changes you would like to see to support increased technology use at school.

7. To what extent do you think access to digital text with text to speech or audio CD satisfied your students' diverse learning needs in this study?

8. Would you be willing to use multiple representation with access to digital text with text to speech or audio CD in assessments for all learners in the future? Why or why not?

9. Describe any concerns you may have with utilizing multiple representation such as text to speech or audio CD in a heavily weighted assessment such as a midterm or a final exam.

10. Would you describe the use of digital text with text to speech as a viable universal design? Why or why not?

11. Do you have any other comments you would like to share or questions for me about the research?