

2018

# UNIVERSAL DESIGN FOR LEARNING IN ONLINE CREDIT RECOVERY: DO COURSE FEATURES IMPACT ACHIEVEMENT?

Robert I. Squires

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UNIVERSAL DESIGN FOR LEARNING IN ONLINE CREDIT RECOVERY: DO COURSE  
FEATURES IMPACT ACHIEVEMENT?

By

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Dissertation

presented in partial fulfillment of the requirements  
for the degree of

Doctorate of Education in Curriculum and Instruction

The University of Montana  
Missoula, MT

Spring 2018

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### **Abstract**

This experimental study investigated whether the addition of course features based on the Universal Design for Learning (UDL) framework impacted achievement in an online English 1A credit recovery course offered by a state virtual school in the Western United States. An alternative format for completing course mastery assignments and eText support tools (ReadSpeaker and TextAid) were added to an existing version of the course. Writing prompts were also included in the alternative mastery assignments. Credit recovery students were randomly enrolled by school personnel into control and treatment sections of the English 1A courses using the enrollment mechanism of the school's Student Information System (SIS). Out of the enrolled students approved to participate in the study (n=133/157), the control section had 68 enrollments, and the treatment section had 65 enrollments.

Experimental data was gathered via pre-test, post-test scores on the four end of module tests. Course grade and final grade data was also provided through the Learning Management System (LMS) and SIS and analyzed using Independent Samples T-Tests. The state Office of Public Instruction provided demographic information on participants. Surveys were used to gather qualitative and quantitative data on the learning experience, and the course instructor was interviewed on perceptions of the course participants, UDL course features and the student learning experience. Results from the experimental aspect of the study demonstrated the null

hypothesis could not be rejected. Mean score gain differences on pre-test, post-test scores were not statistically significant or important across control and treatment groups. Course grade and final grade data also did not demonstrate a statistically significant or important difference in achievement across the groups. Passing rates were higher in the treatment group than the control group (9% based on enrollment numbers, and 5% for individuals). Results from the open-ended survey questions and qualitative interviews revealed three key themes: 1) appreciation of the mastery assignment options 2) the importance of instructor/course mentor support 3) and the initial time commitment of working with the new assignment type for the instructor. Results indicated that an incremental approach to including UDL course features did not result in a statistically significant impact on student achievement. However, the results suggest that a more robust development of the learning experience based on Universal Design for Learning principles may be more likely to increase the impact on student achievement in the courses. The importance of local support on student achievement was also observed. Future research, therefore, might consider a more substantial redesign of the learning experience based on Universal Design for Learning principles as well as additional influences associated with individual engagement and the local learning environment. In addition, it was suggested that researchers also continue to investigate administrative and instructional efficacy when redesigning online credit recovery courses based on UDL principles.

## Acknowledgements

I would like to thank my dissertation committee for their time and support throughout this process. Your feedback and insights were invaluable in helping to refine my understandings and the content of this dissertation. A special thank you to Dr. Morgen Alwell, who chaired the committee, and who has been a key support throughout the entire degree. When I mentioned several years ago that I was interested further study, I was not sure whether it was practical given work and family commitments. Dr. Alwell's confidence encouraged me at that time and has sustained me throughout, and I cannot thank her enough for this. My sincerest gratitude to Dr. Gail McGregor for her insights on major areas of focus in the study. Sincerest gratitude as well to Dr. Matthew Schertz, Dr. Lucila Rudge and Richard Hughes. Their thoughts are reflected in the richness of perspectives represented in this work. I would also like to thank Dr. Jing Jing Son and Dr. Chris Fiore for their insights on testing, and Dr. Patty Kero for her support with the statistics. I believe the study is much stronger for their input.

I would also like to express my gratitude to the administration and staff of the statewide virtual school and the Office of Public Instruction. From first idea, to working through challenges, the administrative team at the virtual school were first-rate. Many thanks as well to the course instructor who was willing to work with me on the course adjustments, and share her perspectives on the student learning experience. Staff in the Office of Public Instruction were also invaluable. The data made available through the Statewide Longitudinal Data System proved essential to the identification of participants. Without all of their help, this work would not have been possible.

I would like to thank my former and current colleagues Dr. Mary Engstrom and Dr. Roger Maclean, whom I have had the privilege to work for during this time. Their belief in me has always been a great source of encouragement. I would also like to thank my colleagues Dr. Nancy Clouse and Marlene Zentz, who have supported me in cross-checking of data and providing insights on various aspects of online course design.

In ending, I would like to recognize my family for their love and support. It is a great pleasure to have the opportunity to make you feel proud.

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## Chapter One: Introduction

Completing high school in the United States is of vital importance to individuals and the nation. High school graduates frequently earn more than their non-graduating peers (U.S. Department of Labor, 2017). They find themselves on pathways to future career success and educational attainment and concomitant improvements in health and life-expectancy (Cutler & Lleras-Muney, 2010). Those who complete high school are also likely to contribute more to the tax base, require less social services, and avoid going to prison (Bridgeland, Dilulio, & Morison, 2006; Dianda, 2008; Harlow, 2003). For many in today's society, success and well-being in contemporary life are substantially premised on the knowledge and skills acquired during high school as well as the diploma that secures access to future opportunities.

Students are at risk of dropping out of high school for a variety of reasons. These have been associated with individual behaviors, values, attitudes, demographics, and learning problems as well as “contextual factors found in students’ families, schools, communities and peers” (Rumberger, 2001, p. 5). Factors that influence the potential of students to drop out include: low educational or work aspirations, cognitive and psychological engagement, gender (pregnancy), race and ethnicity, trauma, language background, socio-economic status, residential and school mobility, external work commitments, the social climate and community poverty (Appleton, Christenson, Kim, & Reschly, 2006; Bridgeland, Dilulio, & Morison, 2006; Iachini, Petiwala & DeHart, 2016; Rumberger, 2001; Tyler & Lofstrom, 2009). As Rumberger and Lim (2008) observe in relation to student’s potential to drop out of school, it is “more of a process

than an event” with two of the most consistent indicators being “early academic performance and students’ academic and social behaviors” (p. 67).

One way to address the impact of poor academic performance is to provide students with opportunities to re-take the courses they have failed. Re-taking courses provides students a means to re-earn lost credit while they continue their path to graduation (Watson & Gemin, 2008). This can help remediate the need for grade retention, which has been shown to increase the probability of students leaving school (Brophy, 2006; Ou & Reynolds, 2010; Range, Holt, Pijanowski, & Young, 2012). Credit recovery opportunities generally provide a great deal of flexibility for students. They can be offered over the summer, on school breaks, after school, on weekends, at home, at night in school computer labs, or even during the school day (McCabe & St. Andrie, 2012). Credit recovery courses can also be offered in a variety of modes on a spectrum from in person to fully distance and synchronous to asynchronous (Picciano & Seaman, 2009). Courses can also be designed in ways to support more individualized learning approaches (Powell, Roberts, & Patrick, 2015), which hold the promise of greater student success.

One particular mode of credit recovery that has grown rapidly in recent years is online credit recovery. Estimates for the number of students enrolled in online credit recovery are not entirely clear because of the lack of systematic processes for identifying online credit offerings across for-profit, non-profit and public credit recovery providers (Barbour, 2013; McCabe, & St. Andrie, 2012). However, according to recent estimates by the Evergreen Education Group, many of the millions of students who take supplemental online courses while attending physical school are doing so to recover credits (Gemin, Pape, Vashaw, & Watson, 2015).

Understandably perhaps, the research literature on the efficacy of online credit recovery approaches has lagged behind the rapid developments in the field. Research has been conducted primarily at the programmatic level (Barbour, 2013; Heppen et al., 2013; Powell, Roberts, & Patrick, 2015; Tyler & Lofstrom, 2009) and so has presented challenges in terms of providing consistent evidence in support of the effectiveness of online credit recovery courses (Heppen et al., 2013). The focus on programmatic successes and challenges, however, has led to the identification of a number of effective strategies for supporting success among online credit recovery students such as engaging students in active learning and providing multiple ways of engaging with learning experiences that promote mastery of content (Powell, Roberts, & Patrick, 2015). Focusing on at-risk students in online credit recovery courses, researchers have also noted the importance of: “assigning faculty and staff to assist students in progressing through their classes, individualizing instruction through the affordances of technology, and developing specific instructional strategies that support achievement” (Archambault et al., 2010, p. 3). Furthermore, the online program and course design standards developed by the International Association for K-12 Online Learning (iNACOL) have done much to improve applications of best practices in the field. The iNACOL National Standards for Quality Online Courses (2011) provide both programmatic and design guidelines to support online student success in virtual schools and courses. The emphasis on providing multiple pathways and ways to engage learners in the National Standards is aligned with major principles in the Universal Design for Learning framework. And yet, in spite of widespread applications of course and program design best practices, there still remains great variation in how the guidelines may be applied at different institutions and in specific courses. The quality of the online learning courses, therefore,

continues to depend upon the approach adopted by the specific program (Woodworth et al., 2015).

Online course design is strongly influenced by the notion that learners come to the experience with individual characteristics that support or hinder their learning. Hartley and Bendixen (2001) observed that: “In addition to self-regulatory skills and epistemological beliefs, other characteristics that need careful consideration include motivation, self-efficacy, ability, physical challenges, and learning disabilities” (p. 25). Hartley and Bendixen (2001) are aware of the importance of making the medium of online learning meet the needs of diverse students. Researchers such as Roblyer, Davis, Mills, Marshall, and Pape (2008) and Jaggars (2011) also operate from the position that if learners do not possess certain characteristics, the learning environment can be adapted to improve the potential learning of those students. This thinking is in line with understandings from recent neuroscience that points to inherent abilities residing within individuals as “learning capacities” (Meyer & Rose, 2005, p. 9). As Meyer, Rose and Gordon (2014) observe:

Personal qualities and abilities continually shift, and they exist not within the individual but in the intersection between individuals and their environment, in a vast, complex, dynamic balance. Each individual varies over time, and responses across individuals to the same environment also vary. (p. 81)

This means that designing online courses for everyone’s success requires attention to the systematic variability among all learners, a variability that is “incremental, distributed, and dynamic, rather than stable and categorical” (Meyer, Rose, & Gordon, 2014, p. 10).

One framework that provides guidelines for designing learning experiences to meet these goals is Universal Design for Learning (UDL). UDL is an inclusive design framework based on principles developed from research into brain functioning and the learning sciences. It provides a means to create instructional goals, methods, materials and assessments that address the predictable variability among learners (NCUDL, 2012). UDL is based on the premise “that barriers to learning occur in the interaction with the curriculum—they are not inherent solely in the capacities of the learner. Thus, when education fails, the curriculum, not the learner, should take responsibility for adaptation” (Meyer & Rose, 2005, p. 6). We may note an echo of Dewey (1902) in this language: the primary role of the educator is to adapt the environment so that individuals can learn, not place the burden of adaptation on the learner. As such, Universal Design for Learning fits within a constructivist paradigm that in contemporary terms posits an active role for learners in constructing knowledge within a socio-culturally situated environment. As knowledge cannot be directly imparted, “instruction should consist of experiences that facilitate knowledge construction” (Jonassen, 1999, p. 217). UDL further speaks to ensuring access for all users by addressing “usability issues such as ease of use, efficiency, memorability, and user satisfaction” (Burgstahler, 2015, p. 77).

As can be seen from the evidence on display at the Center for Applied Special Technology’s (CAST) National Center on Universal Design for Learning (NCUDL), substantial empirical research underpins the UDL framework. UDL’s impact on learner performance and perception of the quality of the learning experience has also been demonstrated in a number of studies (Coyne, Pisha, Dalton, Zeph, & Smith, 2012; Hall, Cohen, Vue, & Ganley, 2015; He, 2014; Kumar & Wideman, 2014). However, much still needs to be done to validate specific universal design interventions in relation to learners in context (Al-Azawei, Serenelli, &



Lundqvist, 2016; McGuire, 2014; Ok, Rao, Bryant, & McDougall, 2017; Rao, Ok, & Bryant, 2014). According to McGuire (2014), there are several ways to address the shortfalls in the current literature, including:

Clarifying the UD framework and principles under study, and linking them to the appropriate principles and guidelines; conducting empirical research on the efficacy of the frameworks on promoting inclusion and learning; [and] pursuing a systematic research agenda that builds the evidence base incrementally. (p. 394-395)

Rao, Ok and Bryant (2014) also suggest that future research needs to “define what an effective UD-based practice looks like” (p. 164).

One recent development that may improve the consistency of the identification of UDL approaches is the UDL scan tool (Smith, 2016). The UDL scan tool allows for the review of the online learning platform based on the UDL framework and can provide the foundation on which to identify how learning is associated with UDL principles. The scan tool operates by providing a method for the subjective evaluation of the online learning platform in relation to UDL principals and checkpoints. This broad level overview of the platform can provide a snapshot of perceived strength and weakness. The tool also provides further connections to evidence-based strategies for improving student learning.

This study used the UDL scan tool to review an English credit recovery course offered at a statewide virtual school. General areas of strength and weakness were identified based on the review. These areas were then cross-referenced against the UDL approaches associated with the UDL checkpoints. The researcher, an experienced instructional designer, also reviewed the

course structure and content to determine where UDL-based course features might be appropriate. The process resulted in the identification of several course features, associated with key principles of the UDL framework. The course features identified for inclusion were: an optional format for completing mastery assignments with writing prompts (sentence starters), and electronic textual support for reading and writing (ReadSpeaker and TextAid). Closed captions were also added to all videos. An additional review of the literature provided further grounds for the inclusion of these course features. The literature was nuanced, but benefits in terms of engagement, motivation, language production, reading skills and satisfaction have been noted for adding choice to assignments (Fulton & Schweitzer, 2011; Patall, Cooper, & Robinson, 2008; Shin & Overbaugh, 2007) offering different assignment format options (Hua, Lee, Stansbery, & McAfee, 2014); incorporating sentence starters (Bulu & Pedersen, 2010; Slavkin-Phillips, 2016); using text-to-speech (Meyer & Bouck, 2014; Stodden, Roberts, Takahashi, & Stodden, 2012) and providing closed-captions (Gernsbacher, 2015; Hayati & Mohmedi, 2011). A good deal of this research supports the benefits of incorporating these features not only for students with disabilities and non-native speakers, but learners not typically associated with having difficulties in the online environment.

### **Research Context**

In 2012, a statewide public virtual school in the Western United States, which provides original credit and supplemental online credit recovery opportunities to public schools, cancelled their agreement with a curriculum provider, Plato, and moved their curriculum into a Learning Management System, Moodle by Moodlerooms. The curriculum was originally developed from the work of North Carolina Virtual Public Schools, and further adapted to meet the needs of the

statewide program and its participants. Without explicitly using the Universal Design for Learning framework, the virtual school used a number of online design best practices that overlap with many UDL principles. Out of conversations with the virtual school leadership, it became apparent that including further UDL principles in an existing course might provide a number of insights that could be of benefit to the school and improve student learning. Including course features that provided students with different options to take assignments could shed some light on the effectiveness of their approach of providing a linear pathway through the content. By integrating a text-to-speech and writing support technology (ReadSpeaker and TextAid), the research could investigate the impact of having multiple ways of presenting and engaging with text-based content as well as investigate commercial products that were understood to have promise by the virtual school. The study could also be designed in a way that honored the virtual school's existing educational model while providing a thorough investigation of student achievement and experiences in a format that could inform future curriculum adjustments. Finally, it became evident that the results would also contribute to the dialogue at national conferences on online credit recovery where UDL principles are beginning to be explored by other virtual schools.

### **Statement of the Problem**

There is a pressing need for research into the effectiveness of online credit recovery approaches as well as applications of the Universal Design for Learning framework in specific learning contexts. Current literature on effective online credit recovery approaches as well as designing effective online recovery learning experiences still has a number of major gaps (Barbour, 2013; Powell, Roberts, & Patrick, 2015). Research into the effectiveness of specific

UDL options in the context of online credit recovery would also contribute to the emerging evidence base in the UDL literature (Capp, 2017; McGuire, 2014; Ok, Rao, Bryant, & McDougall, 2017; Rao, Ok, & Bryant, 2014) and support the development of an effective online credit recovery course and program at a statewide virtual school. In the context of public school policy, it would also help address “the increasing requirements for all schools to provide a Free Appropriate Public Education (FAPE) for students with disabilities (a requirement under Section 504 of the Rehabilitation Act of 1973)” (Johnston, Greer, & Smith, 2014, p. 2).

### **Purpose of the Study**

The purpose of this study is to investigate whether implementing course features based on UDL principles in an online credit recovery course increases student achievement in the online credit recovery course. In doing so, this research will provide insights into the effectiveness of incorporating select UDL-based features into a highly enrolled English 1A credit recovery course, a practice that is in keeping with current incremental approaches to incorporating UDL course features in course design (Rao, Edelen-Smith, & Wailehua, 2015; Tobin, 2014). These insights may further our understanding of the impact of adopting UDL principles on the design of online credit recovery courses as well as contribute to the literature on the effectiveness of UDL-based interventions on learner achievement. It may also more generally contribute to the evidence base in both online credit recovery and Universal Design for Learning.

### **Research Questions**

In order to compare student achievement in the English 1A control section and the UDL treatment section, this study addressed the following primary research questions:

1. Does the inclusion of course features based on Universal Design for Learning principles (mastery assignment options in a quiz format with writing prompts, and integration of ReadSpeaker and TextAid) improve student pre-test, post-test scores in the English 1A credit recovery treatment section in comparison to the control section?
2. Does the inclusion of the course features improve course grades in the UDL treatment section of the course in comparison to the control section?
3. Does the inclusion of the course features improve course completion rates in the UDL treatment section in comparison to the control section?

The researcher was also interested in learning about the student experience in the UDL treatment section and identifying whether the UDL course features were of particular value to participants.

A secondary research question to address the student experience, therefore, was developed:

4. Do participants in the study find the inclusion of the UDL course features worthwhile?

### **Research Hypothesis**

It was anticipated that the inclusion of the UDL course features would improve student achievement, completion rates and course grades of students in the treatment group. In other words, there would be experimentally important and experimentally significant differences between the gains in achievement in test scores of the students who participated in the UDL treatment group and the students who participated in the control group. There would also be experimentally important and experimentally significant improvement in grades and retention as well as qualitative evidence of appreciation for the UDL course features among the UDL treatment group.

The null hypothesis was that there would be no experimentally important or experimentally significant differences between the gains in achievement in test scores and grades of the students who participated in the UDL treatment group and the students who participated in the control group. The null condition also suggests that passing rates would be the same across groups, and there would be no evidence of appreciation of the UDL-based course features.

### **Definition of Terms**

For the purposes of this study, the following definitions are used:

*Credit Recovery.* “A student passing, and receiving credit for, a course that the student previously attempted but was unsuccessful in earning academic credit towards graduation” (Watson & Gemin, 2008, p. 3).

*Online Education.* “Education in which instruction and content are delivered primarily over the Internet” (Watson & Kalmon, 2005, as cited in iNACOL, 2011, p. 7)

*Supplemental Online Program.* A supplemental online program is an online program that enrolls students in individual courses as opposed to a full course of study. The online course provides a supplement to the face-to-face courses taken by the student at his/her “regular” school. (Wicks, 2010, p. 12).

*Virtual School.* “A formally constituted organization (public, private, state, charter, etc.) that offers full-time education delivered primarily over the Internet” (iNACOL, 2011, p. 7)

*Universal Design.* “The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (Center for Universal Design, 2008, para. 2).

*Universal Design for Learning.* “UDL is a set of principles for curriculum development that give all individuals equal opportunities to learn. UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone--not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs” (Center for Applied Special Technology, 2012, para. 1).

### **Delimitations**

The study was delimited to participants who enrolled in the English online credit recovery course sections during the Fall Semester of 2016 and Spring Semester of 2017. The students were in grades 9-12 of a public virtual school in the Western United States. Total enrollment for Fall Semester 2016 was 70. The control section had 33 students and the treatment section had 37 students. Total enrollment for Spring Semester 2017 was 87. The control section had 48 students and the treatment had 39 students. Total enrollment for Fall Semester 2016 and Spring Semester 2017, therefore, was 157: 85 enrollments in the control group and 72 students in the treatment group. The study only included participants whose school principal consented to their participation (n=30/36), which reduced the overall study enrollment numbers to 133 with 68 students in the control group and 65 students in the treatment group.

The study was further delimited to an investigation using the Universal Design for Learning Framework. UDL is one framework for considering the design of inclusive learning online. Other options include Universal Instructional Design and Universal Design of/for

Instruction (McGuire, 2014). Much of these frameworks overlap with the work on Universal Design by Ron Mace (Connell et al. 1997) and principles of good pedagogical practice (Chickering & Gamson, 1987). However, UDL is a scientifically valid framework that has been developed based on understandings from neuroscience and the learning sciences, and so was chosen over the other universal design frameworks.

### **Limitations**

Even though this study utilizes an experimental design, which controls for many of the threats to internal and external validity (Gay, Mills, & Airasian, 2012), there are a few key limitations that will impact the generalizability of the findings. First, the selection of participants into the control and treatment groups, while random, was not controlled directly by the researcher, but by ability for school staff to select one of two course sections when enrolling students. 36 schools enrolled students over the Fall and Spring Semesters. The enrollment timeframe was open for several months in each term. While the process resulted in the likelihood that students would be enrolled randomly in one section or another by the local support staff, the lack of direct control over the process by the researcher, or a mechanism to automate the random placement of students through the SIS, meant there was the potential that the characteristics of certain students could be clustered in one section or another. Analysis of the data did not reveal that to be the case, but a randomization process based on the uncontrolled selection of one of two options was the result of the capacity of the Student Information System and the requirements for the schools to enroll their students in the state virtual school, rather than a formal randomization process.



Out of the 36 schools that enrolled students in English 1A credit recovery course over the two semesters, 6 principals did not give their consent for students to participate in the study. This reduced the overall data set from 157 to 133 enrollments (85%). While the majority of students taking the classes participated in the study, the data does not represent the entire enrollment group. This means that certain participant information and performance was not available for inclusion in the analysis.

Qualitative data was also limited to those who responded to the in-course formative evaluations and the request for consent to participate in the follow-up interviews. It was anticipated that this would result in limited responses to the in-course survey, and limited responses to the request to participate in follow-up interviews. As it turned out, there was substantial responses to the in-course survey because of the requirement for it to be completed before the next module became available. However, requested consent for student interviews was not given from parents or students who participated in the course and whose schools gave consent for their participation. Caveats also remain as to the generalizability of the findings given the unique demographics of the population in the study. The lack of opportunity to engage with students first-hand on their experiences also limits the potential insights available to the researcher. The potential for researcher bias, which was controlled for through active reflection, verification of the coding and member-checking with the instructor (Miles, Huberman, & Saldanna, 2014), may still not be entirely eliminated.

### **Philosophical Underpinning**

While this study is clearly in the tradition of post-positivist experimental research, the author would like to make clear his awareness of the need for a more critical theoretical approach

when designing learning for all users. At its core, Universal Design for Learning can be seen as a framework for achieving educational equity by addressing the socially constructed power structures that marginalize learners who are seen to have certain immutable characteristics. In an insightful piece on the socially constructed nature of disability, Jones (1996) observes that the nature of disability is rooted less “in empirical fact than in a social contract developed primarily by those outside the disability experience” (Jones, 1996, p. 351). This research takes as an understanding that there is a social contract about adequate online learning that is also primarily developed by those outside of the experience of many of today’s learners. Rather than designing for the ‘average’ learner (Rose, 2016), designing to meet the needs of all learners can help to empower individuals who have been on the margins of the educational system. Following the thinking of Giroux (1998) such a critical understanding of the pedagogical approach embodies the idea that we need to take action to raise the ambitions, desires and provide real hope for all learners if we are to provide grounds for educational and social equity.

### **Significance of the Study**

The significance of the study stems from the inclusion of specific design features that may improve the learning experience for online credit recovery students. The investigation of the impact of those features has implications for the design of future online credit recovery experiences at a statewide public virtual school as well as the literature on how to design online credit recovery courses more generally. This information can be used to improve the quality of the instruction, and provide guidance for the development of online courses in a rapidly growing field. Furthermore, it will add to the literature on online credit recovery and on Universal Design

for Learning, which are both in need of ascertaining effective evidence-based practices in context. This may further validate or raise questions about an incremental approach to adding UDL features to courses and their applicability in certain contexts and among particular populations. It will also help define what an effective UD-based practice looks like (Rao, Ok, & Bryant, 2014), and indicate whether there is at least some initial promise in taking an incremental approach to including UDL course features in online credit recovery courses.

### **Summary**

There is a pressing need to research the potential of online credit recovery programs to support learner success given the gaps in existing research and the importance of supporting learners who may otherwise drop out of school. While emerging best practices have resulted in the development of a number of effective programs, utilizing a design framework that supports the inclusion of all learners has the potential to influence learning design positively for students in online credit recovery courses. Universal Design for Learning is one approach to designing online credit recovery programs that holds promise given its grounding in inclusive education and cognitive neuroscience. However, research into applications of the framework in specific contexts is limited. This dissertation will address the need for research in these areas by investigating the impact of the applying course features based on Universal Design for Learning principles in an online credit recovery course.

## **Chapter Two: Review of Literature**

### **Introduction**

This review addresses various aspects of the literature concerning the design of effective online credit recovery courses for diverse students. Following Boote and Beile (2005), the purpose of the review is to “set the broad context of the study” (p. 4) and synthesize the literature so that direction of the present study can be situated in preceding work. To that end, the review will cover several major areas. First, K-12 online courses will be placed in the historical context of distance and online education. Second, research into online education at the K-12 level will be considered. The review will then address the specific concerns of online credit recovery courses. Next, the Universal Design for Learning (UDL) framework will be highlighted and specific design approaches associated with UDL addressed. This will lead us to the decision-making process for the selection of specific UDL course features and their support in the literature.

The review is primarily comprised of studies in online education and credit recovery at the K-12 level as well as studies on Universal Design for Learning. The studies were located in various research databases and using the Google search engine on the web. Databases included Academic Search Complete, LearnTechLib, and ERIC. Google Alerts, which provide keyword activated updates on newly published articles, were also used over a period of 18 months for updates on online credit recovery research and Universal Design for Learning. Further searches were systematically conducted in journals that specifically refer to distance and online education as well as major educational journals such as the American Journal of Distance Education, International Review of Research in Open and Distributed Learning, Online Learning, Educational Research Review, Learning and Instruction, Computers and Education, and Journal

of Educational Computing Research. As most contemporary online credit recovery courses are offered via a web-based platform, the review of literature focused on articles from 2000 to the present, rather than earlier modes of distance education. Research that addressed the North-American context were also prioritized. Primary keywords used in locating the research included: online education, distance education, K-12 online education, K-12 online credit recovery, universal design for learning as well as terms associated with the particular UDL intervention strategies: text-to-speech, writing aids, sentence starters, assignment choice, and closed captioning. Additional time was spent identifying research of interest from the bibliographies of key articles.

The searches and feeds resulted in the identification of numerous articles, which have been organized by relevance to the current study in the following sections: Distance and Online Learning; Effectiveness of Distance and Online Learning; K-12 Online Programs; K-12 Virtual Schooling; K-12 Online Course Design; Supplemental K-12 Online Learning; Online Credit Recovery; Universal Design; Universal Design for Learning; UDL Classification; and, Underpinning Research on the UDL Course Features.

### **Distance and Online Learning**

Learning at a distance has been around as long as it has been practical for a teacher to be able to communicate with a student at a distance (Holmberg, 2005). It is generally thought that by about the mid-nineteenth century distance learning had taken a recognizable form of the contemporary correspondence course, where learning materials, assignments and feedback are sent back-and-forth via the mail system (Holmberg, 2005; Keegan, 1996). Advancements in technology over the next 150 years provided new media by which to engage learners at a

distance. The telephone, radio, television, cassette tapes, compact discs, e-mail, text-messaging, and the networked computer systems that form the Internet and enable the World Wide Web all provided new affordances with which to interact with learners at a distance. As the Web, and Web-based software such as Learning Management Systems, became more interactive in the late 1990's and early 2000's, the technology began to provide the potential for high-quality content and interaction in line with Moore's (1989) recommendations<sup>1</sup>. Over the same period, as the government, educational researchers, and society-at-large began to see the potential of the web to provide greater access and opportunity for learners (Fouts, 2000; Kerrey & Isakson, 2000; Kozma, Zucker, & Espinoza, 1998), the stage was set for the development of models of distance education that primarily relied on web-based online learning.

### **Effectiveness of Distance and Online Learning**

A good deal of early research in distance and online learning focused on the question of whether distance education or face-to-face learning was more effective, and whether the medium of delivery was responsible for any differences. In criticism of the profit-driven motives of technology companies, Clark (1983) highlighted a number of studies where the use of the technology did not make a significant difference to learning outcomes. As Clark (1983) argued: "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition." (p. 445). Throughout the 1990's, Clark's (1983) ideas were supported by the identification of studies that highlighted the No Significant Difference Phenomenon (Russell,

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<sup>1</sup> Moore (1989) highlighted the importance of three types of interaction in distance courses: learner-content, learner-instructor and learner-learner interaction.

2001). Russell's (2001) original compendium of the same name identified 355 reports, summaries and papers covering the majority of the twentieth century in order to confirm the "substantial evidence that technology does not denigrate instruction" (p. xiii). However, in reviewing literature related to the higher education context at around the same time, Phipps and Merisotis (1999) used a less confirmatory approach and suggested care with findings based on studies with unscientific methodologies. Cavanaugh (2001) also noted similar concerns in the K-12 literature.

From 2000 to 2010, several systematic analyses of K-12 online research sought to further understand the comparative effectiveness of distance and online educational outcomes and face-to-face learning (Cavanaugh, 2001; Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004; Means, Toyama, Murphy, Bakia, & Jones, 2009). Cavanaugh's (2001) investigation of effect sizes in 19 studies with publication dates ranging from 1986 to 1997 found a small positive effect in favor of distance education (0.147). However, the small effect size meant that it was not possible to state that interactive distance learning techniques were more effective than traditional approaches, but that educators could expect results "at least comparable to traditional instruction in most academic circumstances" (Cavanaugh, 2001, p. 84). In 2004, Cavanaugh et al. again found that on balance online education "did not outperform or underperform classroom instruction" (Cavanaugh et al., 2004, p. 19-20), and that particular factors such as the mode of distance program or instructional variables did not generate a statistically significant impact on learning. More recently, the influential US Department of Education's meta-analytic Evaluation of Evidence-Based Practices in Online Learning (2009) and its follow-up from the primary researchers, Means, Toyama, Murphy, and Bakia (2013), suggested better outcomes for online and blended approaches over face-to-face approaches. However, with a nod to the early work of

Clark (1983), they again suggested caution in interpreting these results to mean that the online or blended mode of education is better.

In 2006, Rice conducted one of the first literature reviews to summarize the evidence on instructional and environmental considerations in creating effective K-12 online learning experiences. Rice (2006) identified three major areas as significant in the existing research literature: the affective domains, learner supports, and learner characteristics. Affective learning domains involved the students' sense of connectedness through interaction and engagement in the learning. Learner supports included "instructional support, technical support, services that promote a sense of community, and the design of the learning environment" (p. 437), and learner characteristics include "learning style, self-esteem, beliefs, demographics, etc." (p. 435). While the category of learner characteristics is problematic for its inclusion of 'learning styles' (Willingham, Hughes, & Dobolyi, 2015), the areas that Rice (2006) identified are still ones that remain as markers for current research into K-12 online learning (Pourreau, 2015). Roblyer, Davis, Mills, Marshall, and Pape (2008) identified similar areas of focus as Rice (2006), but suggested the overarching categories of "learner characteristics and studies of the characteristics of learning environments" (2008, p. 90-91). Learning environments included the interactional elements of teacher-student and student-student interaction as well as the design of the learning experience.

In spite of this solid ground work in framing areas of research focus, relatively little research has been conducted on the factors that affect K-12 learning success online (Barbour, 2015), especially at the high school and elementary level. Referencing the comments made by Rice (2006) on this topic, Barbour (2017a) expressed the contemporary state of the field thus: "A



full decade later, this theme is still a relatively accurate description of the field of K-12 distance, online, and blended learning...practice continues to outpace the availability of useful research.” (p. 2). In regard to the original questions of the comparable effectiveness of online learning, however, consensus has emerged over the first decade of the 21<sup>st</sup> century around its effectiveness (Means, Toyama, Murphy, & Bakia, 2013). The substantial questions that remain, therefore, center around which learning conditions best meet the needs of increasingly diverse online learning populations.

### **K-12 Online Programs**

The investigation into the effectiveness of specific learning environments for students is complicated by the variety of K-12 online learning programs. Since the Florida Virtual High School (FLVS) began offering supplemental online courses as early as the 1996-1997 school year (Clark & Barbour, 2015), various types of online programs have proliferated. Online programs are now widely offered as full substitutions as well as supplements to traditional schooling. Online programs may serve students working independently or with support at school and at home. Instructional support may be in person or online, asynchronous or synchronous. The programs may serve students locally, regionally and nationally, and may be operated by the state, district, college or university, consortium, non-profit or for-profit organizations (Clark, 2001; Watson, Gemin, Ryan, & Wicks, 2009; Watson, Winograd, & Kalmon, 2004).

The proliferation of programs is symptomatic of the substantial growth that has occurred in the field. By late 2009, Watson, Gemin, Ryan, & Wicks (2009) observed that: “45 of the 50 states (plus Washington D.C.)” have “a state virtual school or online initiative, full-time online schools, or both” (p. 8). In the 2014-2015 school year, Miron and Gulosino (2016) observed: “33

states had full-time virtual schools—many of them charters.” (p. 10). Most prominent among these virtual schools are the for-profit Educational Management Organizations (EMOs), K12, inc. and Connections Academy, accounting for “57.4% of all full-time virtual school students in 2014-2015” (Miron & Gulosino, 2016, p. 38).

### **K-12 Virtual Schooling**

The research that exists on K-12 virtual schooling is sporadic and concerning. As Watson, Pape, Murin, Gemin, and Vashaw (2014) observed, there is still not a great deal of “meaningful information and evidence...for most digital learning activity” in K-12 online schools and courses (p. 7). When considered at the educational outcome level in particular, the evidence suggests that virtual schools greatly lag behind traditional approaches to schooling (Miron & Gulosino, 2016). Of the 62 state education authorities that provided accountability ratings (just 14% of the total), only 19 (31% of this group) received acceptable ratings in 2014-2015 (Miron & Gulosino, 2016). The on-time graduation rates for students in virtual schools was also greatly lower: “only 40.6% of students at virtual high schools and 37.4% at blended schools graduated on time, whereas the national average for all public high schools was more than double at 81.0%.” (p. 29). In specific subject areas, virtual schools also lag behind traditional brick-and-mortar schools. Comparing the percentage of students who scored proficient in reading and mathematics on state assessments, Harris-Packer and Ségol (2015) observed that in the “eight of the ten states examined, the performance of the online schools is worse than the average for the state” (p. 15). Charter schools fared equally as poorly. The Stanford CREDO report on virtual charter schools concluded that: “Academic benefits from online charter schools are currently the exception rather than the rule” (Woodworth et al., 2015, p. 63).

These negative results can be difficult to interpret given the array of programs and their pedagogical approaches to online education, and the varying expertise and resources of program designers. However, one reason why virtual schools may show such achievement gaps is that they are increasingly serving a more diverse population. In the early years of virtual schooling, the typical student was identified as self-motivated and academically independent (Clark, Lewis, Oyer, & Schreiber, 2002; Haughey & Muirhead, 1999; Kozma, Zucker, & Espinoza, 1998). More recently, virtual schools often take enrollments from across the educational spectrum (Repetto, Cavanaugh, Wayer, & Liu, 2010). It should be noted, though, that the population is still not as diverse as in traditional schools. According to Miron and Gulosino (2016), there are fewer numbers of minority and lower income students, English Language Learners (0.1%), male students (47.5%), and students with disabilities (7.2%) than in the traditional school system. The poor performance of virtual schools when serving an increasingly diverse population, one that is not yet fully representative of the typical school population, further exacerbates the concern for researchers such as Barbour (2015).

Another possible explanation for the performance gap is that virtual school students, especially in for-profit virtual schools, are not getting the attention they need. As Miron and Gulosino (2016) observe:

While the average student-teacher ratio in the nation's public schools was 16 students per teacher, blended schools reported more than twice as many students per teacher (32.4 students per teacher), and virtual schools reported more than twice as many students per teacher (35 students per teacher). Virtual schools operated by for-profit EMOs had the

highest ratio (44 students per teacher), while those operated by nonprofit EMOs had the lowest (19.5 students per teacher). (p. 21)

The literature strongly supports the notion that having fewer students in class impacts student achievement positively, both in immediate terms and long-term “human-capital formation” (Schanzenback, 2014, p. 10). It is also noteworthy that the “payoff from class-size reduction is greater for low-income and minority children, while any increases in class size will likely be most harmful to these populations” (Schanzenback, 2014, p. 10). This should not surprise teachers familiar with online and in-person instruction delivered in a constructivist paradigm (Vygotsky, 1978). There is simply less time for instructors to provide meaningful feedback to individual students if there are more of them to engage. As Hattie (2009) has also made clear from his extensive analysis of the impact of feedback on learning, providing feedback is among the most powerful influences on student achievement (Hattie, 2009; Hattie & Gan, 2011).

### **K-12 Online Course Design**

Without a substantial research base on the effectiveness of online environments and instructional practices, program providers have often turned to the National Standards for Quality in Online Courses developed by the International Association of Online Learning (iNACOL) to guide their course and program development (Barbour, Clark, DeBruler, & Bruno, 2014). More recently, a number of schools are also using the Quality Matters Course Design Rubric Standards. Both of these rubrics suggest a number of key design areas and use rating scales to guide and evaluate program features. For example, the National Standards for Quality in Online Courses (2011) identifies 5 key design areas:

A. Content: The course provides online learners with multiple ways of engaging with learning experiences that promote their mastery of content and are aligned with state or national content standards.

B. Instructional Design: the course uses learning activities that engage students in active learning; provide students with multiple learning paths to master; the content is based on student needs; and provides ample opportunities for interaction and communication – student to student, student to instructor, and instructor to student.

C. Student Assessment: The course uses multiple strategies and activities to assess student readiness for and progress in course content and provide students with feedback on their progress.

D. Technology: The course takes full advantage of a variety of technology tools, has a user-friendly interface and meets accessibility standards for interoperability and access for learners with special needs.

E. Course Evaluation and Support: The courses evaluated regularly for effectiveness, using a variety of assessment strategies, and the findings are used as a basis for improvement. The course is kept up-to-date, both in content and in the application of new research on course design and technologies. (iNACOL National Standards for Quality Online Courses, 2011, p. 8-18)

For instructional designers or administrators familiar with quality assurance in online higher education, the identified areas seem familiar to the recommendations in the research-informed Quality Matters higher education rubric (Shattuck, 2015a). While there is a good deal

of research literature to support the higher education rubric, the literature in support of the K-12 rubrics is more limited. Adelstein and Barbour's (2016) scholarly review of the literature in support of the National Standards above identified a number of studies to support the five major categories. However, Adelstein (2016) revealed that "the lack of K-12 online course design research" (p. 110) required them to supplement the K-12 literature with studies that included participants in higher education. As a result, "the content validity or "support" for numerous elements" in the National Standards rubric may be "somewhat questionable" (p. 111). In Shattuck's (2015b) review of the literature in support of the Quality Matters K-12 rubric, a number of studies that supported the major areas of the rubric were also highlighted. Shattuck (2015b) also noted that as the field continues to develop more efforts are being made to bridge the gap between using adult learning models of learning to address a population that has different learning needs (Shattuck, 2015b). However, the need for additional research on how to design effective K-12 online programs remains clear as best practices continue to remain informed by higher education research.

### **Supplemental K-12 Online Learning**

One area that has been more promising for K-12 online education (Barbour 2013; Barbour, 2017) is when online courses are developed as supplements to face-to-face courses taken by the student at his/ her "regular" school (Wicks, 2010, p. 12). For example, in their investigation of a large, mid-western virtual school, Liu and Cavanaugh (2012) explored how the characteristics of learners and the learning environment impacted achievement in virtual high school algebra courses. Liu and Cavanaugh (2012) found that students in the Algebra I course were positively influenced by teacher interaction in both the first and second half of the term.

They found that time logged into the LMS was positively correlated with student achievement in Algebra I (second-half), and Algebra II (first and second-half). Full-time students also performed better than part-time students.

While promising, it is important to interpret supplemental online results in relation to the population under investigation (Barbour, 2015). As Oliver, Osborne, Patel, and Kleiman (2009) have observed different populations can experience courses in different ways. In their mixed method study of student experiences in North Carolina Virtual Public School online courses, Oliver, Osborne, Patel, and Kleiman (2009) observed that:

Accelerated students were significantly more likely to rate the quality of their course as high on a scale from 1 (poor) to 4 (excellent) ( $M = 2.90$ ,  $SD = 0.87$ ) compared to students taking credit recovery courses:  $M = 2.68$ ,  $SD = 0.92$ ;  $F(1, 702) = 9.35$ ,  $p < .002$ ,  $\eta^2 = .01$ .  
(p. 40)

Teacher surveys indicated that a potential reason for this was that credit recovery students appear to sometimes lack the self-motivation and discipline required to be successful. Other characteristics may also influence outcomes in the course. In the Liu and Cavanaugh (2012) study, for example, the sample was characterized as “primarily white, aged between 15 and 18, not participating in school free or reduced lunch programs, and part-time online students without individual educational plans” (p. 160). This could be interpreted as a relatively privileged academic group. Therefore, it is important to consider the extent to which the population composition, then, influences outcomes in supplemental and online courses, especially as we consider the increasing diversity of online learners. Research by Heissel (2016) has shown the need to be vigilant on this point as even higher achieving students may struggle comparatively in

an online Algebra class compared to their peers taking an in-person class.

In an investigation of the comparative effectiveness of supplementary Algebra and English online courses at Florida Virtual School, Chingos and Schwerdt (2014) explored whether achievement in the traditional high school courses was more effective than the online courses. Chingos and Schwerdt (2014) compared the 10<sup>th</sup> grade test scores on the Florida Comprehensive Assessment Test with 8<sup>th</sup> grade test scores among students who had similar demographics and test scores and took one or more of the Algebra or English courses through FLVS. The strategy controlled for gender, age, race, limited English proficiency, free or reduced-price lunch eligibility and special education status. The results were favorable: “students who took English I or Algebra I through FLVS score higher on the reading or the math test than non-FLVS students.” (p. 12). Even controlling for 8<sup>th</sup>-grade scores, produced “statistically significant estimates of the FLVS impact in both subjects, with point estimates of 0.07 in reading and 0.04 in math.” (p. 12).

Chingos and Schwerdt (2014) also found that the population taking the online courses was substantially different from the traditional school population:

Compared to non-FLVS students, FLVS students are 14 percentage points less likely to be eligible for a free or reduced-price lunch, five points less likely to be in special education programs, and 12 points more likely to be white. On the 8<sup>th</sup>-grade state tests in math and reading, FLVS students scored 0.35 standard deviations higher, on average, than non-FLVS students. (p.10)

While the authors concluded that they do not find: “any evidence of negative effects of virtual



education on student learning” (p. 14), this cannot explain the potential impact of supplemental approaches to online learning when the population is more in line with students who have typical demographics and test scores. In fact, students who dropped the courses within the 28-day trial period permitted by the FLVS were not included in the analysis of achievement. As I believe Barbour (2014) correctly observes, it is most likely the students who drop during the trial period who are the very students less likely to be successful in the first place.

Supplemental online course research has also been challenged by methodological issues of the kind apparent in much educational research. For instance, Cavanaugh, Gillan, Bosnick, Hess, and Scott (2008) investigated whether student performance in an online Algebra course was improved by the graphing of linear equations using an online tool. Cavanaugh et al. (2008) found a greater mean increase in scores among the group that used the graphing tool. However, out of the 101 participants, the control group had 30 participants while the treatment group had 71. With almost twice the numbers in the treatment group, it is difficult to ensure that the variance is equal among the groups, a key assumption for parametric statistical tests. As Cavanaugh et al. (2008) note, the improved test scores could also be explained by the students in the treatment group being more motivated or higher achieving academically than the participants in the other group. The study remains one of quality, and it has been observed that this study provides some evidence that instructional design changes to an online course may impact achievement positively (Lowes, cited in Ferdig & Kennedy, p. 87). However, the unequal groupings of data simply demonstrates one of the challenges experienced by researchers working in pre-determined educational contexts.

In another widely cited study on online Algebra, Hughes, McLeod, Brown, Maeda, and

Choi (2007) examined the achievement and perceptions of students in online and face-to-face conditions of the course. Achievement was measured using the Assessment of Algebraic understanding test, and classroom perceptions were measured using the What is Happening in this Class? instrument. Principals at the virtual schools selected three virtual school classes and the researchers compared them with comparable traditional algebra classes in three states. Similar to the Cavanaugh et al. (2008) study, the control and treatment groups had highly unequal groupings. 85 students in three traditional classes were compared with 25 students in three online algebra classes. Hughes et al. (2007) observed that: “online students consistently outperformed traditional students across the AAU subscales, despite having lower proportions in a college preparation path.” (p. 205). However, Hughes et al. (2007) note the inability to statistically control for the impact of prior knowledge on the results as they could not access prior test score data on Algebra through the virtual schools. They conclude that the “fact that online students had higher achievement than traditional students—despite being older, less likely to be on a college- bound path, and more likely to report that this course was not their first Algebra course—suggests that online learning may be a viable academic option for some students.” (p. 207). However, as the researchers recognize, it is very difficult to draw much from the study beyond this suggestion. The fact that the Independent T-test is challenged by being unable to determine a baseline academic equivalence (normality) among the populations gives pause in accepting the results at face value. The use of self-report data for student demographics also raises questions as to the reliability of this data as well.

One study that used a sample that was a more representative of the general population was Johnson and Barbour’s (2013) study of Advanced Placement (AP) test scores at the Florida

Virtual High School (FLVS). The sample permitted student participation regardless of prior GPA and required participants to complete the AP test, and so the test results were a good measure of an open enrollment process. The data indicated that students performed at levels consistent with the national sample and at higher rates compared with other Florida students (6%). This might suggest that the experience was very rewarding or that students who chose to participate were already in a strong position to complete the AP test online. As the GPA of the FLVS AP group was not compared to state and national standards and information on those who dropped the AP course in the 28-day grace period was not included, some reservations remain as to whether the comparison populations were equal, but the results again re-inforce the potential of supplemental approaches to online learning supporting student achievement. An additional point of interest from the study was the mixed perceptions of students on the learning experience. Some students appreciated the flexibility of the environment and the ability to make progress on their own terms, while others missed the interaction that a face-to-face environment provides.

The literature on K-12 supplemental online learning, therefore, consistently points to the efficacy of supplemental approaches to online learning. However, the research highlights the importance of the student population in supplementary online experiences, especially in regard to their previous academic success. It also highlights the challenges in conducting studies that determine the effectiveness of one approach over another given the exigencies of educational contexts that are difficult to control experimentally. However, as also noted by Barbour (2015), it is becoming increasingly clear from supplemental online credit recovery studies that supplemental approaches to online learning can be effective learning experiences.

## **Online Credit Recovery**

Online credit recovery courses and programs are offered to students who have been unsuccessful in previous academic courses (Watson & Gemin, 2008) and are partly responsible for the rapid growth in K-12 online education (Gemin, Pape, Vashaw, & Watson, 2015). The formats for online credit recovery may vary (McCabe & St. Andrie, 2012), but, broadly speaking, online credit recovery courses differ from other forms of K-12 online education in terms of the personalized support provided for students. Increased personalization is born out of the concern for populations that may include students who have failed a course previously or may be at risk of dropping out of school. As Powell, Roberts and Patrick (2015) observe:

Many online programs serving credit recovery and at-risk students—but not all—have a significant face-to-face component for student supports. The blended approach provides expanded counseling, tutoring, and support services including face-to-face contact with teachers, who provide not only subject-area support, but also guidance on effective study skills. (p. 22)

The need for supportive faculty and staff is widely referenced in the literature (Dessoff, 2009; Archambault et al. 2010; Oliver & Kellogg, 2015). Based on a review of several successful programs, Archambault et al. (2010) identified the following areas as key in supporting at risk learners: “support from teachers, learning coaches, counselors, tutors, and special education coordinators” (p. 5). Individualizing instruction and utilizing a mastery-based instructional approaches, where students progress when they have demonstrated the requisite levels of achievement, were also thought to support at-risk student success (Archambault et al., 2010). Neiffer (2016) has also identified the value of an orientation to online learning to support

learners, which includes: “not only the structure and logistics of the courses we offer but also the basics of successful online learning—everything from email etiquette to how to upload documents.” (para. 8). This is in line with researchers and who have suggested the need for additional support where necessary for students more likely to struggle in an online environment (Archambault et al., 2010; Frazelle, 2016; Roblyer & Marshall, 2002).

It is worth noting here that an at-risk population is not necessarily the same as a credit recovery population. As Watson and Gemin (2008) point out: “A student who fails several classes is likely to be at-risk, but a student who fails only one class may not be. Conversely, a student may be identified as at-risk due to a variety of factors despite not having failed a single class” (p. 6). This makes for an academically diverse population in online credit recovery courses. Individuals may be academically high-achieving or have struggled with traditional approaches to learning.

As with much of the research into online programs at the K-12 level, there have been calls for more research into the experiences of students in credit recovery programs (Lewis, Whiteside, & Garrett-Dickers, 2015). While several recent studies provide useful insights (Stallings et al., 2016; Heppen et al., 2016; Oliver & Kellogg, 2015), the results have been mixed for online credit recovery students (Stallings et al., 2016). Individual differences among learners as well as the instructional practices employed in the online credit recovery courses have been identified as possible reasons for the challenges experienced (Stallings et al., 2016; Heppen et al., 2016; Oliver & Kellogg, 2015).

In an exploration of the relative efficacy of online or face-to-face credit recovery courses conducted among North Carolina Public Schools, Stallings et al. (2016) found that there was “little difference in the short-term success rates (such as end-of-course exam scores) between NCVPS credit recovery students and other credit recovery students.” (p. i). However, Stallings et al. (2016) note that the NCVPS group were typically less economically disadvantaged and had higher grades on their Grade 8 exams than the comparison population. Stallings et al. (2016) found that:

On measures of longer-term success (such as graduation rates), NCVPS credit recovery students were less likely than other credit recovery students to graduate, but those who did graduate were more likely to stay on track to graduate (by succeeding in subsequent related coursework) and to graduate on time (that is, within four years). (p. i).

They conclude from the evaluation that there are no clear strong and positive associations between participation in NCVPS credit recovery over other credit recovery options. Conversely, there are neither significant negative associations (Stallings et al., 2016). Stallings et al. (2016) further suggest the need to explore the impact of online credit recovery on specific subgroups that may struggle more in the online environment as English Language Learners and African American students were less successful than their peers in online credit courses (Stallings et al., 2016). In an investigation of the experiences of African American students in an urban alternative school, Lewis (2016) found that participation in an online learning program can be a “positive experience” (p. 106), but that the impact on the credit recovery approach on learning remained unclear.

In a comparison of the effectiveness of in-person and online credit recovery algebra courses, Heppen et al. (2016) randomly assigned students who failed a 9<sup>th</sup> grade algebra courses into face-to-face or online Summer credit recovery sections (n=1224). While no differences were found in the level of student perception of engagement or of teacher support, Heppen et al. (2016) found that:

Students in the online course perceived the course to be significantly more difficult than students in the f2f course ( $d = 0.51$ ). Students in the online course also reported experiencing significantly less clarity about what they needed to do to succeed in the class than students in the f2f course ( $d = -0.64$ ). (p. 18)

Students in the online course also had significantly lower scores on the end-of-course post-test relative to their f2f counterparts, and students who took the online Algebra IB course had lower credit recovery rates, lower scores on an end-of-course algebra assessment, and less confidence in their mathematical skills than students who took an f2f credit recovery class (Heppen et al., 2016). The face-to-face condition, therefore, seemed to favor student success.

One explanation that Heppen et al. (2016) put forward for these results is that the online class may have simply been too hard for students with weak mathematical skills who had failed their prior algebra class. Instructors had control over the content that they taught, and many of the instructors in the face-to-face condition taught a number of remedial math topics where those in the online section relied solely on the second semester algebra curriculum. As Heppen et al. (2016) observe: “By including content from first-semester algebra and pre-algebra, the f2f teachers may have provided instruction on topics for which students were ready and could

understand.” (p. 21). The results of this study highlight the importance of the support structures identified by Watson and Gemin (2008), and Archambault et al. (2010) and also suggests the potential for adaptive approaches to support the different level of challenge that the course may offer to different levels of students (Heppen et al., 2016).

Studies that have investigated success indicators in online credit recovery courses have also provided insights into which students tend to take the courses and perform better. In an investigation of the characteristics of students taking Florida Virtual School courses, Jacob, Berger, Hart, and Loeb (2016) investigated which characteristics most strongly predicted the use of credit recovery online courses among the FLVS students. They found that among economically disadvantaged students (those receiving subsidized lunch), there was “an almost 6.0-percentage-point reduction in the likelihood of making credit recovery attempts virtually” (Jacob, Berger, Hart, & Loeb, p. 260). For Jacob, Berger, Hart and Loeb (2016), this raised the specter of further inequality of opportunity for those in a worse position to take advantage of the online learning opportunities. However, Jacob, Berger, Hart and Loeb (2016) suggest that “if lower-achieving and relatively disadvantaged students accurately perceive that they would benefit more from face-to-face instruction than from virtual instruction, the differential patterns in uptake would not be worrisome.” (p. 260). However, it is not clear to this researcher whether this population would have such a perception.

In Robinson-Carlton’s (2016) examination of the factors that predict success or failure in an online credit recovery program, further performance factors were identified. Robinson-Carlton (2016) found that as pre-test scores increased the odds of passing the course substantially increased. Robinson-Carlton (2016) also found that as the number of absences increased, the



odds of completing the course decreased. In addition to these quantitative findings, Robinson-Carlton (2016) reported included qualitative data (n=4) that suggested in combination that the predictors of success were:

- 1) self-efficacy - one's belief in one's own ability to complete tasks or accomplish goals,
- 2) engagement or time spent on task, 3) participation or one' willingness to complete the task, 4) a high score on a module's pretest, and 5) few absences due to apathy or discipline issues. (p. 96)

Put in terms of the type of students who perform better, Robinson-Carlton (2016) notes that the factors that cause individuals to take credit recovery options in the first place are also the ones that can cause them to struggle in the online credit recovery course: “failures, absences, discipline issues, time (not enough to complete course requirements), and available resources (limited).” (p. 12).

There is more limited research on the impact of online credit recovery approaches on students with disabilities, but these are clearly populations that need to be served by virtual schools (Repetto, Cavanaugh, Wayer, & Liu, 2010). Students with disabilities are also likely to be among those at risk (Spitler, Repetto, & Cavanaugh, 2013). While some of the challenges faced by students with disabilities can be alleviated when students “self-select their pace for course completion” (Allday & Allday, 2011, p. 224), individuals with different disability types may still perform at different levels in online courses (Allday & Allday, 2011). Carnahan and Fulton (2013) further note that in order to meet the needs of students with diverse abilities in online courses: “Having the ability to modify curriculum and make special adaptations for these learners is just a component that needs to be considered as a best practice” (p. 52).

In one of the few empirical studies investigating the needs of students with disabilities in a virtual school program, Spitler, Repetto and Cavanaugh (2013) interviewed the CEO from a Northeastern public virtual charter school. They examined the extent to which a virtual school program utilized 5 research-based approaches: developing learner control, a flexible and rigorous curriculum, a safe climate, a caring community and connection to students as individuals and their future goals. As reported by the CEO, Spitler, Repetto and Cavanaugh (2013) found a number of these ‘5C’ supports in place at the public virtual charter school. However, it also became apparent that the instructional staff would benefit from: “specific training in understanding the nature of disabilities and their impact on individual learning needs” (p. 13). The authors concluded that educators would also benefit from training in the 5C’s framework.

As can be seen, the existing research on K-12 online credit recovery is sporadic and has had mixed results. Citing the work of Stevens and Frazelle (2016), Frazelle (2016) observes: “research on what constitutes an effective credit recovery program remains limited, particularly in regard to specific strategies that could be linked to higher student passing rates” (p. 3). Given some of the potential challenges faced by individuals online as well as limitations in the effectiveness of some online learning environments, some researchers have suggested that online credit recovery may not be for everyone (Oliver & Kellogg, 2015). However, given the increasing availability of online credit recovery options, it seems a more equitable approach would be to re-frame the issue as one of the effectiveness of the learning environment and less of the ineffectiveness of the learners. This focus embraces the idea that engaging all learners in online learning is a design challenge that may have multiple solutions.

## **Universal Design**

Universal Design originated out of the work of architects, product designers, engineers and environmental design researchers, who sought to design “products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (The Center for Universal Design, 1997, para. 2). It has since been extended to the design of educational experiences in order to maximize the impact of instruction (Burgstahler, 2001; Scott, McGuire, & Shaw, 2003), instructional design (Fox, Hatfield, & Collins, 2003), and learning (Rose & Meyer, 2002). Universally-designed educational frameworks are grounded to varying degrees in the research of the learning and pedagogical sciences, neuroscience, and cognitive psychology. The National Center on Universal Design for Learning, for example, takes the neuropsychological knowledge that our learning brains are composed of recognition networks, strategic networks and affective networks and maps these to learning principles (NCUDL, 2012). Providing learning solutions that address this predictable variability provides all learners the greatest opportunities to succeed. Put in slightly different terms, Universal Design accomplishes its aim of universality through building flexibility into learning experiences so that everyone benefits from the available options.

As can be seen from the evidence on display at the National Center for Universal Design (NCUDL, 2012), substantial empirical research underpins the universal design framework. However, much still needs to be done to validate specific universal design frameworks and particular interventions in relation to learners in context (McGuire, 2014; Rao, Ok, & Bryant, 2014). Failing to research the effectiveness of UD implementations in relation to

specific frameworks can raise the specter of educators using invalidated interventions and promulgating what turns out to be a fad (McGuire, 2014).

### Universal Design for Learning

Universal Design for Learning draws its educational approach primarily from empirical research into the brain using various imaging techniques, and so starts with brain networks as the foundations for the learning framework. The learning brain is composed of affective networks, recognition networks, and strategic networks (NCUDL, 2012). These networks need to be activated in order to learn. Affective networks relate to the need for emotional engagement. Recognition networks relate to the need for representation, and strategic networks relate to the role of controlling action and expression (NCUDL, 2012). The principles of Engagement, Representation, and Action and Expression are further developed into 9 guidelines that can be used for designing instruction (Rao, Smith, & Lowrey, 2017). These 9 guidelines are associated with an additional 31 checkpoints that cover a number of best educational practices in the field of education. A representation of the framework is presented in the figure below:

	<b>Provide Multiple Means of Engagement</b>	<b>Provide Multiple Means of Representation</b>	<b>Provide Multiple Means of Action &amp; Expression</b>
	Affective Networks the “WHY” of Learning	Recognition Networks the “What” of Learning	Strategic Networks the “How” of Learning
<b>A C C E S S</b>	Provide options for <b>Recruiting Interest (7)</b> Optimize individual choice and autonomy (7.1)	Provide options for <b>Perception (1)</b> Offer ways of customizing the display of information (1.1)	Provide options for <b>Physical Action (4)</b> Vary the methods for response and navigation (4.1)

	Optimize relevance value and authenticity (7.2) Minimize threats and distractions (7.3)	Offer alternatives for auditory information (1.2) Offer alternatives for visual information (1.3)	Optimize access to tools and assistive technologies (4.2)
B U I L D	<b>Provide options for Sustaining Effort &amp; Persistence (8)</b> Heighten salience of goals and objectives (8.1) Vary demands and resources to optimize challenge (8.2) Foster collaboration and community (8.3) Increase mastery-oriented feedback (8.4)	<b>Provide options for Language &amp; Symbols (2)</b> Clarify vocabulary and symbols (2.1) Clarify syntax and structure (2.2) Support decoding of text, mathematical notation, and symbols (2.3) Promote understanding across languages (2.4) Illustrate through multiple media (2.5)	<b>Provide options for Expression &amp; Communication (5)</b> Use multiple media for communication (5.1) Use multiple tools for construction and composition (5.2) Build fluencies with graduated levels of support for practice and performance (5.3)
	<b>Provide options for Self-Regulation (9)</b> Promote expectations and beliefs that optimize motivation (9.1) Facilitate personal coping skills and strategies (9.2) Develop self-assessment and reflection (9.3)	<b>Provide options for Comprehension (3)</b> Activate or supply background knowledge (3.1) Highlight patterns, critical features, big ideas, and relationships (3.2) Guide information processing and visualization (3.3) Maximize transfer in generalization (3.4)	<b>Provide options for Executive Functions (6)</b> Guide appropriate goalsetting (6.1) Support planning and strategy development (6.2) Facilitate managing information and resources (6.3) Enhance capacity for monitoring progress (6.4)
I N T E R N A L I Z E	<b>Expert learners who are...</b>		
	Purposeful & motivated	Resourceful & Knowledgeable	Strategic & Goal-Directed
G O A L			

Figure 1. Universal Design for Learning Guidelines Version 2.2. Adapted from graphic organizer, Center for Applied Special Technology (2018).

Studies that have explicitly addressed the impact of the Universal Design for Learning framework on student learning are still limited in number, and how they classify the UDL-based intervention is varied (Ok, Rao, Bryant, & McDougall, 2017). To illustrate some of this variety, we need only review a few of the learning contexts in the studies identified by Ok, Rao, Bryant, & McDougall (2017) in their meta-analysis on UDL interventions. These include: individualized shared-stories for students with disabilities (Browder et al., 2008); a reading-literacy program that used UDL- scaffolded ebooks and software program (Coyne, Pisha, Dalton, Zeph, & Smith (2012); a universally designed web-based text-environment for reading (Dalton, Proctor, Uccelli, Mo, & Snow, 2011); computer-based and online supports for vocabulary acquisition and comprehension (Hall, Cohen, Vue, & Ganley (2015); classroom-based UDL interventions for a science course (Dymond et al., 2006); and, a UDL designed module on the ‘mole’ for a chemistry curriculum (King-Sears et al., 2015).

As Universal Design for Learning principles are flexible enough to be employed at the micro and macro level of designing the learning experience and may be considered pedagogical or technological interventions, it is clear that the UDL intervention must be explicitly clarified in relation to the UDL principles and indicators (Rao, Ok, & Bryant, 2014). Furthermore, as the strategies used to design UDL experiences may be very different, there is need to continue to study different applications of UDL-based approaches to further refine the knowledge-base on different types of UDL in practice.

In the analysis of the effect sizes of these diverse interventions, Ok, Rao, Bryant, and McDougall (2017) found that: “the magnitude of intervention effect sizes varied from small to large within and across most of the pertinent studies...; in other words, the efficacy of UDL-

based instruction varied considerably in these studies.” (p. 134). In a metaanalysis of UDL literature that included pre-test, post-test interventions, Capp (2017) observed that the results from the 18 studies identified for inclusion supported “the hypothesis that UDL is effective at improving the learning process for all students” (p. 805). However, the effect sizes reported again varied greatly in range as did the participants, context of implementation, UDL strategies used and relation to UDL principles. We may also note the significant variation in methodologies, and the lack of studies that used a true experimental design. Of particular need, then, are methodological approaches that permit statistical procedures that fit the investigation at hand if we are to determine the impact of UDL interventions on educational outcomes. The use of T-tests, ANCOVA or other parametric tests for quasi-experimental research designs is fraught with potential threats to internal and external validity.

At the time of writing, no published studies investigating the impact of Universal Design course features in online credit recovery courses were found. However, there is an awareness of the potential benefits of incorporating UDL principles into online courses more generally (Bakia et al., 2013; Dell, Dell, & Blackwell, 2015). Research also supports the inclusion of Universal Design for Learning principles in courses for students with disabilities. For example, Woodworth et al. (2015) found that: “ELL students and SPED students of a given race-ethnicity have weaker expected growth than students of the same race-ethnicity who are not ELL or SPED; however, ... online charter schools are more successful in minimizing these negative impacts relative to their sector average in math.” (p. 32). The researcher is also not aware of any studies investigating the impact of UDL-based interventions in other types of key credit recovery courses such as English 1A.

## **UDL Classification**

Given the diversity of possible implementations of Universal Design for Learning, a good place to begin is to review the tools available for analyzing the learning environment based on UDL principles. Al-Azawei, Serenelli, and Lundqvist (2016) developed an evaluation tool that addresses the accessibility of content in state manuals, such as teacher guides and administration manuals. The tool might also lend itself to guide the evaluation of test-item development. However, a more comprehensive tool was recently developed by Center on Online Learning and Students with Disabilities (COLSD), the UDL scan tool. The UDL scan tool “offers a way for teachers, curriculum specialists, parents, and other district personnel to determine how online content aligns to the UDL principles, guidelines, and related checkpoints. (Smith & Basham, 2014, p. 136). The tool, therefore, can be used to determine the UDL alignment of the courses and possible areas that could be strengthened by the inclusion of additional strategies. As noted on the COLSD website, “the Tool offers educators, parents, and developers a way to further examine online learning products, and a mechanism by which to consider what might be missing in order to best meet the learning needs of ALL individuals” (COLSD, 2017, para. 1).

## **Underpinning Research on the UDL Course Features**

From an application of the UDL scan tool, as well as conversation and review based on the researcher’s and dissertation committee chair’s expertise, the following key areas were identified for inclusion in the English 1A credit recovery course offered by a statewide virtual school:



- The need for multiple ways for students to respond to mastery assignments (choice of assignment formats)
- The need to scaffold the writing process through written prompts (sentence starters)
- The need for multiple ways for students to engage with and compose course content (auditory as well as text-based; text-to-speech technology; writing support technology)
- The need for multiple ways to access information in videos (closed-captions)

The inclusion of these items closely aligned with multiple UDL principles: optimize individual choice and autonomy, vary the methods for response and navigation; offer ways of customizing the display of information; promote understanding across languages; activate or supply background knowledge; and, use multiple tools for construction and composition. Further research into the literature was conducted to ascertain the direct evidence-base for the inclusion of these items.

**Assignment choice.** The impact of providing choice to students in the completion of assignments has support in the literature, although the impact of the choices may differ based on individual preferences and motivation for task selection (Flowerday & Shell, 2015). It may also be the case that options that have unequal learning outcomes can decrease student learning as Fulton and Schweitzer (2011) noted in their study of the impact of alternative homework assignments in an introductory computer science course. Fulton and Schweitzer (2011) gave 10% of the final course grade to an activity where students could choose to use a software-based programming assignment or an application-oriented assignment that involved analyzing a problem and using various software tools to solve and document it (Fulton & Schweitzer, 2011). They found that those students who took the programming-based choice, which most closely

modeled the skills needed on the exam, performed slightly better in the final. The students disproportionately affected were those who were already struggling in the class. Incorporating assignment choice, therefore, resulted in the potential to reduce student achievement and impact learning. As Fulton and Schwietzer (2011) put it: “the cost of providing that flexibility is that students may not receive the same level of learning experience. As a result, their overall performance, and grade can be affected” (p. 11). Ensuring equitable grading practices and comparable demands in terms of assignment effort, therefore, may not be sufficient to ensure that students get the best possible learning experiences from the choices on offer if achievement on the final exam is supported more effectively by one type of assignment over another.

One way to ensure the equality of the learning experience is to provide choice among the type of assignment while keeping the assignment requirements the same. This is the approach that Hua, Lee, Stansbery, and McAfee (2014) followed in their study of the impact of providing an alternative format for multiplication problems for students with special needs. As Hua, Lee, Stansbery, and McAfee (2014) note: “modifying the task presentation format may alter student task preference without compromising academic integrity (e.g., making the assignment easier or shorter) and can enhance the feasibility of including choice as an instructional component in applied settings” (p. 102). Assignment modification was shown to have a modest effect on academic productivity among the students and was most noteworthy among the student who had a particularly strong preference for one activity over another.

The notion of learner interest in the choices making a difference to performance is also supported by the work of Bambara, Ager and Koger (1994). Again working with students with disabilities, they found that engagement was highest when students were given a task that they

highly preferred among the choice options. If a choice was less preferred, students were less engaged (Bambara, Ager & Koger, 1994). Moreover, as Killu, Clare and Im (1999) have noted, the choice format itself may not be as significant a factor as the preference for completing a task in a particular way. In a single-subject study of students with learning disabilities, Killu, Clare and Im (1999) observed:

Though existing research indicates that providing choices may result in favorable performance outcomes for students with disabilities, providing an individual with the opportunity to choose does not necessarily reflect an individualized intervention. Individualized intervention is reflected in activities that meet the needs, interests, preferences, and abilities of students. (p. 251)

Research conducted by Caygill and Eley (2001) also supports the notion that students favor the task format that they think they are best at. Moreover, when a task is perceived as boring, the inclusion of the choice can be detrimental to performance (Patall, 2012). While it is clear that choice can motivate learning interest, therefore, it is by no means guaranteed to do so by the nature of there being a choice present. Individual preferences for the choices, motivation, expected outcomes, and understanding of self-efficacy can all play a role in moderating the influence of the choices on learning. Ensuring that the choice-option provides an equivalent learning experience is also key when conducting research on the impact of adding an alternative assignment choice (Hua, Lee, Stansbery, & McAfee, 2014).

**Sentence starters.** Many individuals struggle with writing, especially those with learning disabilities (Graham & Harris, 2009). Web-based technologies have been shown to have the potential to support the writing development of struggling learners (Englert, Zhao, Dunsmore,

Collings, & Woblers, 2007), but additional written support in the form of sentence starters or writing prompts can also help scaffold composition for learners. These may be developed by the instructor or by class peers as ‘writing tips’ for other students (Wong, 2015). Studies that have investigated the use of writing prompts to scaffold learning have observed their potential to support different levels of learners in responding to the task requirements (Lee & Songer, 2004).

In a quasi-experimental study of middle school students using different types of writing prompts for problem-based learning task in a science class, Lee and Songer (2004) found that that high-achieving students used the scaffolds more frequently than less achieving students. When the scaffolds were removed lower achieving students in the unscaffolded condition did not perform as well as those in the scaffolded condition. This suggests that sentence starters can support student learning and that they should be offered consistently as an additional support throughout a program or course. Bulu and Pederson (2010) also found that scaffolds served as a cognitive tool to help learners deal with complex problem solving. Domain-specific scaffolds such as sentence starters, they argue, should be more rightly seen as a cognitive tool to aid composition as their removal can negatively impact the performance of student unequally. Research on the use of sentence starters among university age population has also provided qualitative evidence of their helpfulness (Slavkin & Phillips, 2016).

**eText support tools for reading and writing.** The use of text-to-speech as an option to provide additional support for learners who have reading difficulties has been well-supported in the literature. An early study by Elkind, Cohen and Murray (1993) on the impact of a computer-based reader on 28 middle school students diagnosed with dyslexia, showed marked improvements in their reading ability and comprehension in the computer-based reader group.

The software “enabled more than half of the students in our sample to read with greater comprehension (at least one grade level higher) than they could read unaided. For about 40 percent of the students, the gains were large, the equivalent of two to as much as five grade levels” (p. 258). As Elkind, Black and Murray (1996) observed: “computer readers can be an important compensatory tool for adults with dyslexia, a tool that allows them to read at a level more commensurate with their intellectual ability and that helps them attain their goals.” (p. 185). eText support tools have also been shown to support individuals with attention disorders. Among 20 college students identified as having attention disorders, Hecker, Burns, Katz, Elkind, and Elkind (2002) found that the Kurzweil 3000 assistive reading software had a positive impact on reading ability. The software also improved students’ attention to the readings, reduced their distractibility, lowered stress and fatigue, and increased the length of reading time (Hecker, Burns, Katz, Elkind, & Elkind, 2002). More recently, Stodden, Roberts, Takahishi, Park, and Stodden (2012) found that participants in two pilot studies, n=35, and n=69, significantly improved reading skills when using Kurzweil 3000. The researchers attributed this to the use of the etext support tool, and the “steady pace of auditory and visual input of text for the struggling readers’ whose typical reading is slow and halting.” (p. 362). Poor readers performance was also enhanced by being able to set the reading speed at higher speeds than which they were usually accustomed. (Stodden et al., 2012).

In a test-delivery situation, the use of a speak-a-aloud technology among high-school students with a learning disability also resulted in positive outcomes. Dolan, Hall, Banerjee, Chun and Strangman (2005) investigated the impact of a software-based alternative to paper and pencil test completion. Dolan et al. (2005) observed that: “providing computer-based read-aloud support to high school students with learning disabilities can improve their performance on a

multiple-choice United States history and civics test.” (p. 21). Dolan et al. (2005) also tied their study to the theoretical model of UDL, noting that:

It is important to remember that the goal of universal design is to support all users, not only those with disabilities. As such, any testing solutions that reduce construct irrelevancy will improve the validity of decisions made upon test scores. To this extent, we must be willing to embrace assessment techniques that provide students with the best opportunity to demonstrate their knowledge and skills, even at the expense of presentation “consistency”. (p. 25).

This recommendation is consistent with the research approach in the current study in provisioning an alternative assignment format using the ‘quiz format’ in Moodle for mastery assignments options. While providing a different option of format was significant in the study, care should be taken with the recommendations as the study only included 9 participants (Dolan et al., 2005).

In further alignment with the goals of Universal Design for learning, researchers have also noted the potential for additional features incorporated in the textual support software to support reading ability. As Rao, Dowrick, Yuen, and Boisvert (2009) observe, the multimedia functions of computers: “allow students to access and interact with information in visual, textual, and aural ways. Students who are stronger with one mode of processing information than another can start with their area of strength.” (p. 29). Over a number of years, Anderson-Inman and Horney (2007) developed a typology of resources typically found in eText support tools. The typology, which was used to guide the work of the National Center for Supported eText, includes an identification of the type of resource, a description of the resource and examples of the kind of

affordances the resource provides for the learner. As Anderson-Inman and Horney (2007) suggest, the typology can be used to assess the particular value of eText support tool when selecting it for use. The typology is presented in the table below:

Table 1.

*NCEST typology of resources for supported eText, Anderson-Inman and Horney (2007), p. 154*

Resource	Description	Examples
Presentational	Enables the text and accompanying graphics to be presented in varying ways, hence customizable to meet the needs of individual readers	Font size and style, text and background color, line and page length, page layout and juxtaposition with other pages, graphics in relationship to text
Navigational	Provides tools that allow the reader to move within a document or between documents	Within-document links, across-document links, embedded menus, links from other resources such as Table of Contents, Glossary, Bibliography
Translational	Provides a one-to-one equivalent or simplified version that is more accessible or familiar to the reader. May focus on a word, phrase, paragraph, picture, or whole document. May be of same or different modality or media	Synonyms, definitions, digitized or synthesized text-to-speech, alternate language equivalents (Spanish), video of American Sign Language translation, simplified version at lower reading level, text descriptions for images, captions for video
Explanatory	Provides information that seeks to clarify the what, where, how, or why of some concept, object, process, or event.	Clarifications, interpretations, or descriptions that point to causes, operations, components, mechanisms, parts, methods, procedures, context or consequences; list of influencing factors
Illustrative	Provides a visual representation or example of something in the text. Designed to support, supplement, or extend comprehension of the text through illustrations or examples.	Drawings, photos, simulations, video, photos, reenactments, sounds, music, information that something is representative of its type (“...is a typical example of...”)
Summarizing	Provides a summarized or condensed way of viewing some feature of the document.	Table of contents, concept map, list of key ideas, chronology, timeline, cast of characters, abstract
Enrichment	Provides supplementary information that is not strictly needed to comprehend the text, but adds to the readers’ appreciation or understanding of its importance or historical context	Background information, publication history, biography of the author, footnotes, bibliography, influence on other writers
Instructional	Provides prompts, questions, strategies or instruction designed to teach some aspect of the text or how to read and interpret the text	Tutorials, self-monitoring comprehension questions, annotations, instructional prompts, study guides, embedded study strategies, online mentoring, tips for effective reading
Notational	Provides tools for marking or taking notes on the text to enable later retrieval for purposes of studying or completing assignments.	Electronic highlighting, bookmarking, margin notes, outlining, drawing. Ways to gather and group these notes for post-reading review.
Collaborative	Provides tools for working or sharing with other readers, the author, or some other audience.	Threaded discussion, online chat, e-mail links, podcasts, blogs
Evaluational	Provides materials, prompts, and assignments designed to assess student learning from the text	Questions, quizzes, tests, surveys, online interviews, assignments leading to products



The reading and writing support tools incorporated into the English credit recovery course in this study are ReadSpeaker and TextAid. ReadSpeaker is primarily a text-to-speech tool, which can be accessed anywhere in the online course pages. In terms of the typology above, ReadSpeaker provides presentational and translational functionality. Text and words can be highlighted as they are read, customizable options for viewing are present and include the ability to download an mp3 and listen offline or at different speeds. TextAid is tool that supports written composition and playback of writing. In the NCEST typology, it can be classified as presentational, translational and notational. A list of its support functionality is further identified in the methodology section of this paper.

The multi-faceted ‘resources’ available through eText support tools such as ReadSpeaker and TextAid result in a number of possible impacts on learning that have been less well-researched in the literature. Commenting on the potential of eText software to impact learning, Anderson-Inman & Horney (2007) note the need to conduct more research on the effectiveness of the various dimensions of the resources on supporting learning. The impact of these features “is fragmented and inconclusive on many, if not most, dimensions.” (Anderson-Inman & Horney, 2007, p. 156). In terms of support of written work with technology, Batorowicz, Missiuna, & Pollock (2012) also observe that “the outcome of using technology on the writing of children with learning disabilities has not been reviewed critically, and this knowledge is necessary for evidence-based practice” (p. 211). The support for the use of reading support technologies, however, has been much more widely researched and has generally noted a positive impact on students with reading disabilities (Buzick & Stone, 2014; Li, 2014). Most recently, Wood, Moxley, Tighe, and Wagner (2018) conducted a systematic review of the impacts of reading support technologies on individuals with reading disabilities. They identified

43 articles for full review. Effect sizes were calculated for 22 articles with the exception of single-subject studies. The results noted the positive affect on reading comprehension for text-to-speech and read-aloud technologies: “Text-to-speech/read-aloud presentation positively affects reading comprehension for individuals with reading disabilities, with average weighted effect sizes of  $d = .35$  ( $p < .001$ ).” (p. 9). Even when the population was narrowed to K-12 students, Wood, Moxley, Tighe, and Wagner (2018) obtained similar results,  $d = .36$  (.13, .58)  $p < .01$ . (p.5)

Clearly, further studies are needed to understand the particular effects of the specific reading and writing support tools with individuals with varying needs if we are to understand the mechanisms that best support student learning (Izzo, Yurick, & McArrell, 2009; Wood, Moxley, Tighe, & Wagner, 2018). However, there is sufficient evidence to suggest that these tools support individual learning needs within a course. They also provide an ever-present support option, which has the potential to empower individuals to complete their work without the need to request additional accommodations. Creating environments that do not require individuals to identify as having a disability are major concerns of web-based accessibility focused groups such as the W3C Accessible Online Learning Community, and the IT Accessibility Constituent Group of EDUCAUSE.

**Closed captioning.** Research has supported the inclusion of closed-captions on video content for various populations, including the hard of hearing, non-native speakers of English and those learning to read (Gernsbacher, 2015; Linebarger, 2001; Shea, 2000). A population at particular risk in English courses are English Language Learners (ELLs). ELLs may vary greatly

in their background, abilities and needs. As explained in a policy research brief from the National Council for Teachers of English:

Some ELL students come from homes in which no English is spoken, while some come from homes where only English is spoken; others have been exposed to or use multiple languages. ELL students may have a deep sense of their non-U.S. culture, a strong sense of multiple cultures, or identify only with U.S. culture. (2008, p. 1).

For students who have English as a non-native language, the research has for some time pointed to the benefits of captions for language and vocabulary acquisition, and listening comprehension (Hayati & Mohmedi, 2011; Huang & Eskey, 1999; Shea, 2000). In an experimental study of the impact of closed-captions on vocabulary acquisition, language proficiency and content knowledge, BavaHarji, Alavi and Letchumanan (2014) also noted a significant impact on the post-test vocabulary acquisition and language proficiency among the experimental group ( $n=92$ ,  $t = -6.92$ ,  $p = .000$ ).

For educational institutions, questions on the value of adding closed-captions have for some time been superseded by the legal requirement to make content available to those who have hearing impairments (Information and Communication Technology Standards and Guidelines, Section, 1194, 2017). Given the legal requirements and the fact that the viewer can choose to activate the captions or not, there are few reasons not to include captions on video content. As Gernsbacher (2015) comments on an extensive review of the closed-captioning literature, the studies “demonstrate that captions benefit everyone who watches videos, from younger children to older adults. Captions are particularly beneficial to persons watching videos in their non-

native language, children and adults learning to read, and persons who are D/deaf or hard of hearing (Gernsbacher, 2015, p. 196).

Captioning quality standards have been developed by the [Described and Captioned Media Program](#), funded by the U.S. Department of Education and administered by the National Association of the Deaf. Closed captions are most effective when they are:

- (1) synchronized and appear at approximately the same time as the audio is delivered,
- (2) equivalent and equal in content to that of the audio, including speaker identification and sound effects; and
- (3) accessible and readily available to those who need or want them.” (para. 3).

Adding closed-captions to video content may help support all learners in an English credit recovery class and also provide further support to those who struggle with literacy or language skills. Ensuring that the captions meet the DCMP standards will most likely provide most benefit to students.

## **Summary**

Over the last two decades, there has been substantial research to support online approaches to education. While less support exists for the effectiveness of online education at the K-12 level, evidence points to its potential effectiveness when designed in such a way as to maximize connection of online learners with supportive individuals. In credit recovery situations, both instructional support and the online learning environment are of particular importance. Working from the scientifically valid framework (UDL) and identifying further additions to the learning environment that can support learning achievement is consistent with an inclusive and

social-constructivist educational paradigm designed to benefit all learners. Research into design applications of the Universal Design for Learning framework in credit recovery situations are very much in their nascent stages, but related literature suggests the potential to impact student achievement positively. This investigation will reveal whether the specific changes, identified through an application of the UDL scan tool, are sufficient to improve the learning achievement for all students, including those who are at risk of school failure.

## **Chapter Three: Methodology**

### **Introduction**

This experimental study investigated the impact of UDL course features on student achievement in an online credit recovery course. Participant experience with the changes was also explored. A statewide virtual school created two versions of an English 1A credit recovery course for Fall Semester 2016 and Spring Semester 2017. The UDL (treatment) section was modified to include the additional UDL course features. The control section maintained the original course format. The impact of the UDL course features was observed through quantitative and qualitative data. Quantitative data included comparative mean gains on pre-test, post-test scores, course grades and the final exam, ReadSpeaker and TextAid usage, passing rates, and survey scales. Qualitative data included student survey responses and an interview with the course instructor.

### **Purpose**

The purpose of this experimental study was to investigate the impact of applying course features based on UDL principles to an English 1A online credit recovery course. The UDL course features added to the treatment section included: an additional mastery assignment choice for each assignment with sentence starters, and the inclusion of the eText support tools, ReadSpeaker and TextAid. Closed-captioning of videos were also included in both sections of the credit recovery courses. The study aimed to explore whether the inclusion of these specific course features improved student achievement. In doing so, the impact of making curricular adjustments based UDL principles for the design of online credit recovery courses was

investigated, and a key area of need in the literature relevant to both online credit recovery and universal design for learning addressed.

### **Research Design**

The research employed an experimental design where students were randomly enrolled by school personnel into two sections of an English credit recovery course in Fall 2016 and Spring 2017 Semesters. The control section did not include additional UDL course features, and the treatment section included the following additional UDL course features: mastery assignment options in a quiz format with writing prompts, ReadSpeaker (text-to-speech) and TextAid (writing support tool). Due to how video content was stored in the video repository, closed captions created for the treatment section of the course were applied to both control and treatment sections. Course content and assessments were otherwise identical and both course sections had the same instructor.

Assignment of participants to the two control and treatment sections of the course was handled through the Student Information System (Genius). To enroll in the virtual school course, students had to work with a teacher, counselor or other member of the school staff. Through the virtual school site, the school staff member had the option to enroll the student in one of two sections of the English 1A course. The course sections were identified as being one of two options with no difference between them. Once the course cap of 40 students had been reached in either section of the course, the option to enroll in the other section was removed by Genius. If a student dropped from a section, then Genius would re-open that section for enrollment. School staff had the ability to enroll students in Fall Semester 2016 from 8/31/2016 to 11/7/2016 and in Spring Semester 2017 from 11/7/2016 to 3/30/17.

In Fall Semester 2016, the process resulted in a control group of 37 total enrollments and a treatment group with 33 total enrollments (n=70), and in Spring Semester 2017, a control group of 48 total enrollments and a treatment group with 39 total enrollments (n=87). The total number of enrolled participants was 157. Due to the research requirement of school principal assent for student participation in the study, 24 enrollments could not be included in the study. The total enrollments eligible for analysis became 133. These enrollments were made by 118 individuals. Demographic data on these participants included GPA, gender, free and reduced-price lunch status, and whether students had a limited English proficiency or an identified disability. Student achievement in both sections was measured on pre-test, post-test scores in the 4 course modules. Final course grades and completion numbers were also analyzed across sections. Usage statistics for ReadSpeaker and TextAid were tracked using the administrative portal provided by ReadSpeaker. In addition, participant evaluations from an in-course and course drop survey were included to provide insight on the course experience. Finally, an interview with the course instructor was conducted.

The study employed an experimental pre-test post-test control group design. Students were assigned to two course sections by a local member of staff tasked with enrolling students in either of the two sections presented by the SIS. In order to measure the increase in mean test score achievement, pre-test, post-test differences in the four modules were compared using an Independent Samples T-test. An Independent Samples T-test is preferable for measuring score gains when the variance among group is homogenous as was the case in this study. The mean scores were based on the participation of 30/36 schools, which resulted in a combined total of 133 enrollments by 118 individual for Fall Semester 2016 and Spring Semester 2017. Achievement was also measured by examining the mean score gain differences in course grades



and final exam scores. Comparative passing rates were also identified across courses and semesters. The quantitative data was supplemented by a formative survey on course experience conducted after the first module, a survey completed by students who dropped the course, and a follow up-interview with the course instructor. Permission was not granted from parents or students to be interviewed on the students' course experiences, and no responses of value were received from the drop survey.

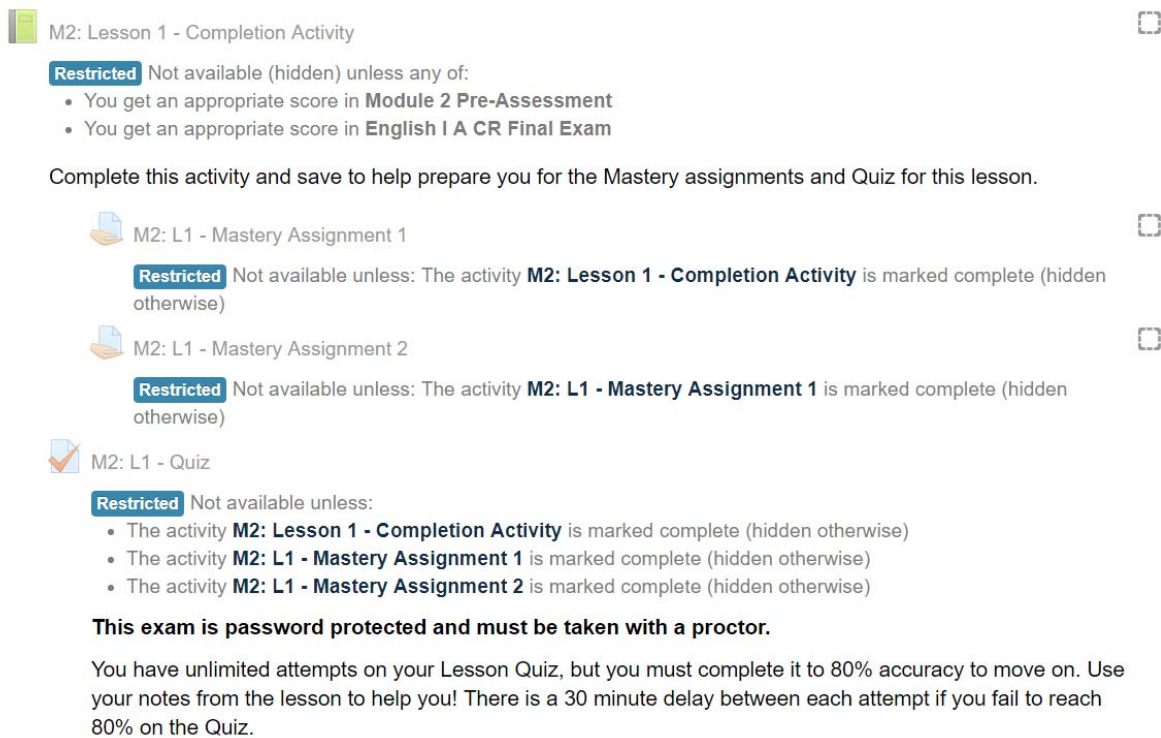
### The Course

The English 1A credit recovery course was designed to have students' progress through its content as they demonstrate mastery of assignments, module quizzes, and written work to the required levels. The course followed the format developed for all credit recovery courses at the virtual school and is represented in the figure below:

79% or lower, students go to lesson 1	←	Pre Assessment One attempt 30 minute limit Proctor required	→	80% or higher, students skip the Module and move to next Module
<p><b><u>Lesson 1</u></b></p> <p><b>Completion Activity Opens</b> – Contains the main content for the lesson. This must be viewed by the student to move on.</p> <p><b>Mastery Assignment 1</b> - Students demonstrate lesson understanding through a turn in assignment. Must be viewed to immediately move on, but must earn 65% or better (graded by coach) to release Module Post-Assessment.</p>		<p><b><u>Lesson 2</u></b></p> <p><b>Completion Activity Opens</b> – Contains the main content for the lesson. This must be viewed by the student to move on.</p> <p><b>Mastery Assignment 2</b> - Students demonstrate lesson understanding through a turn in assignment. Must be viewed to immediately move on, but must earn 65% or better (graded by coach) to release Module Post-Assessment.</p>		



As can be seen from the figure above, each module has a pre-assessment, which allows students to test out of the module if they get a score of 80% or better. This is followed by several ‘lessons’. Each lesson has a ‘completion activity’, which provides the majority of instructional content. Completion activities are followed by ‘mastery assignments’. Mastery assignments are followed by a multiple choice ‘lesson quiz’, which covers the instructional content of the lesson. For example, in the first module, there are 3 lessons. Lesson 1 has 1 completion activity and 2 mastery assignments, followed by a lesson quiz; Lesson 2 has 1 completion activity and 1 mastery assignment, followed by a lesson quiz; and, Lesson 3 has 1 completion activity and 1 mastery assignment, followed by a lesson quiz. If students do not pass the lesson quiz, there is an additional remediation activity to complete before they can progress to the next lesson. After completion of the last lesson in a module, students can take the module post-assessment.



M2: Lesson 1 - Completion Activity

**Restricted** Not available (hidden) unless any of:

- You get an appropriate score in **Module 2 Pre-Assessment**
- You get an appropriate score in **English I A CR Final Exam**

Complete this activity and save to help prepare you for the Mastery assignments and Quiz for this lesson.

M2: L1 - Mastery Assignment 1

**Restricted** Not available unless: The activity **M2: Lesson 1 - Completion Activity** is marked complete (hidden otherwise)

M2: L1 - Mastery Assignment 2

**Restricted** Not available unless: The activity **M2: L1 - Mastery Assignment 1** is marked complete (hidden otherwise)

M2: L1 - Quiz

**Restricted** Not available unless:

- The activity **M2: Lesson 1 - Completion Activity** is marked complete (hidden otherwise)
- The activity **M2: L1 - Mastery Assignment 1** is marked complete (hidden otherwise)
- The activity **M2: L1 - Mastery Assignment 2** is marked complete (hidden otherwise)

**This exam is password protected and must be taken with a proctor.**

You have unlimited attempts on your Lesson Quiz, but you must complete it to 80% accuracy to move on. Use your notes from the lesson to help you! There is a 30 minute delay between each attempt if you fail to reach 80% on the Quiz.

*Figure 3.* Example Module Layout in Moodle. The figure indicates the restrictions on the availability of certain items based on the successful completion of other items. For example, Mastery Assignment 1 will only be made available when an appropriate score on the final exam from the previous unit and the unit pre-test are achieved.

An example of the Completion Activity assignment, where the primary content for the course is located, is also presented in the figure below:

The screenshot displays a Moodle interface for a completion activity. On the left, a 'TABLE OF CONTENTS' sidebar lists four items: '1. Conducting Research on the Internet', '2. Evaluating Websites', '3. Completion Activity 1', and '4. Completion Activity 2'. The main content area is titled 'M1: Lesson 1 Completion Activity' and contains the following text:

**1. Conducting Research on the Internet**

Nonfiction is literally defined as "NOT fiction," the branch of literature that is based on fact and reality. Examples of nonfiction include essays, textbooks, news articles, and biographies. It is often important for us to be able to distinguish reliable nonfiction from the non-reliable.

In Lesson 1, you will examine nonfiction sources and their reliability. You will need to use your most critical eye here, as you will see various websites and online articles, some of which can be trusted, and some of which should not. You will need to print a copy of the Dupe Detector checklist to use as you follow along the Website Evaluation videos, and you may want to print additional copies to use for your own future research. When you complete this lesson, you will be equipped with strategies you can use to help you evaluate the nonfiction sources that surround you every day.

The following slideshow, adapted from [readwritethink.org](http://readwritethink.org), will guide you through the basics of internet searching and evaluating search results.

After you finish viewing, return to the main page where you will learn how to use the [Dupe Detector](#) checklist for website evaluation.

View the following presentation:

The video player shows a title card with the text 'Wading through the Web' and 'Conducting Research on the Internet'. The card also features a large play button and a 'Jing' logo in the bottom right corner.

*Figure 4.* Presentation of Primary Content. The figure indicates the presentation of content within a Moodle 'book' format. Text and media is the primary content within the English 1A Completion Activities.

## UDL Scan Tool

In order to position this online credit recovery study within the UDL framework, the course was analyzed using Smith's (2016) UDL scan tool. This also suggested areas where a course may benefit from the inclusion of additional course features. Drawing on the researcher's and dissertation advisor's expertise in teaching and instructional design, the need for alternative formats for mastery assignments, sentence starters to support composition, and the use of eText support tools were identified. Captions were also identified for inclusion. These were ultimately

placed on all videos in the control and treatment sections of the course as the video repository was linked to both sections of the course. The inclusion of the course features relate to several of the UDL principles and checkpoints, most notably Principle II, Checkpoint 5.2. Use multiple tools for construction and composition, and Principle III, Checkpoint 7.1: Optimize individual choice and autonomy.

The UDL scan tool is designed to evaluate an online learning product by asking the evaluator a series of questions that are tied to the UDL principles and checkpoints framework. All 9 principles and 31 checkpoints are identified as part of the tool. If certain questions are answered in the affirmative, then a number of sub-questions related to the principle are then asked and a point-score is given for each of the responses within that category. An example of a scan tool question is presented below:

#### 5.2 Use multiple tools for construction and composition

Does this product offer EMBEDDED multiple options to support learners' demonstration of understanding when constructing and composing responses? This could include spellcheck, calculator, outlining tools, or games.

- Yes
- No
- Don't know
- Not applicable

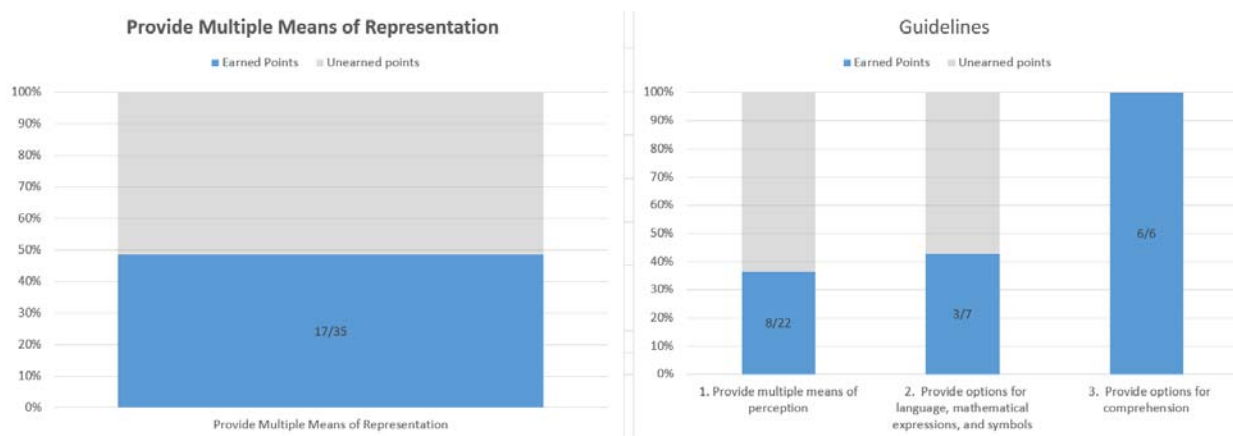
Check all of the composition and construction support tools that are embedded in the product:

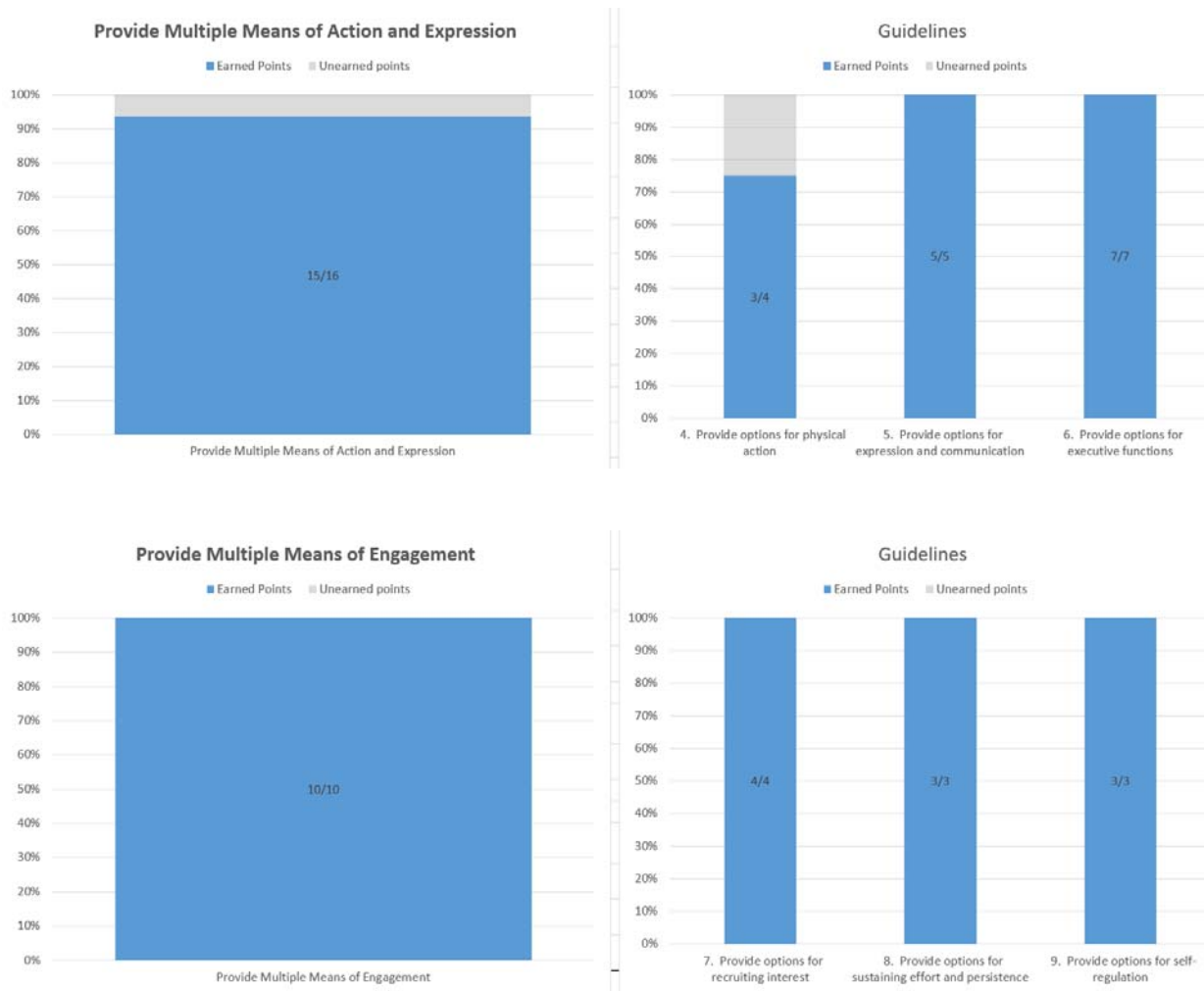
- Spell checkers
- Word prediction tools
- Grammar check

- Sentence starters
- Outlining tools
- Story web
- Concept mapping tools
- Preformatted reporting tools
- Calculator
- Sketchpad/drawing
- Virtual math manipulatives
- Music composition
- Video editor

UDL scan tool, question 5.2, Smith (2016)

If a response is provided that indicates the strategy or function is available in the course, then points are awarded for the response in the category. Once a response has been completed, data from the survey can then be downloaded into an excel file and pasted into a UDL analysis framework to provide a graphic presentation of the data. The totals for each category relate to the score in each of the three main UDL categories. The UDL analysis template, then, can offer a snapshot of the learning experience in relation to Universal Design for Learning Principles. The researcher's evaluation of the student learning experience in the English 1A Credit recovery course is outlined in the following figures:





*Figure 5.* Scan Tool Evaluation of the English 1A Course. The images represent the researcher's evaluation of the courses ability to meet the various checkpoints in the UDL framework. Providing Multiple Means of Representation as well as Action and Expression were both identified as areas that could be strengthened.

Given that the scan tool was designed to primarily evaluate the technological framework, a number of items were not applicable in the evaluation of the course experience for the English 1A course. For example, the credit recovery course is not designed to have students engage with their peers, but the technology does permit this to occur. Differing pedagogical approaches, then, can impact the learning environment as much as the technology being used. It is, therefore, important to also consider the pedagogical decisions made in the design of the learning

experience in evaluating how effectively an environment meets UDL principles. However, the series of questions presented in the evaluation are still helpful to researchers reflecting upon applications of UDL in pedagogical terms. Based on a reflection on the capabilities of the technology as well as pedagogical decisions made in the course, therefore, the following five areas appeared to be particularly salient in terms of potential further UDL course design and development: offer ways to customize the display of information; promote understanding across languages; activate or supply background knowledge; vary the methods for response and navigation; use multiple tools for construction and composition; and, optimize individual choice and autonomy. The inclusion of the optional assignment choice with sentence starters, and ReadSpeaker and TextAid technologies seemed likely to positively impact the quality of the experience for students across all of these areas. Additional research into the literature also supported this decision.

### **Mastery Assignment Option**

An additional mastery assignment option was built into the framework of the course by creating a ‘quiz’ option for students. Students could choose between a Word assignment submission and a quiz assignment submission. The assignment type included the original mastery assignment option and the same mastery assignment built within the quiz tool of the LMS. This allowed students to choose one assignment type or another. Hua, Lee, Stansbery, and McAfee (2014) found that keeping the type of response requirements the same had a positive



effect on learner achievement. An example of the modification from the student and administrative perspective is presented below:

The screenshot displays a Moodle course interface. At the top, there is a section titled "M2: L1 - Mastery Assignment 1 Options" with a checkbox on the right. Below this, a text block explains that there are two options for completing the assignment: one using a Microsoft Word document and another using a web page. A "Restricted" label indicates that this content is only visible if the activity "M2: Lesson 1 - Completion Activity" is marked complete. Below the text, two options are listed: "M2: L1 - Option 1 Mastery Assignment 1" and "M2: L1 - Option 2 Mastery Assignment 1". Each option has a "Restricted" label and a list of conditions: "The activity M2: L1 - Mastery Assignment 1 Options You have tw... is marked complete (hidden otherwise)" and "The activity M2: L1 - Option 2 Mastery Assignment 1 is incomplete (hidden otherwise)". Each option also has a checkbox on the right for selection.

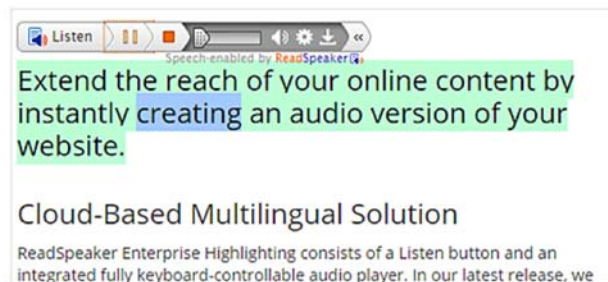
Figure 6. Logic Added to Course to Create the Optional Assignment – Teacher View. The figure represents the inclusion of the choice of assignments: option 1 and option 2. Once the M2: Lesson 1 – Completion Activity has been completed, the student is presented with two options. S/he selects the option by checking the box presented on the right of the image.

The screenshot shows the "Restrict access" settings for a Moodle course. Under the "Access restrictions" section, the "Student" dropdown is set to "must", and the "match" dropdown is set to "all". Below this, two restrictions are listed: "Activity completion" for "M1: Lesson 1 Completion" with the condition "must be marked complete", and "Activity completion" for "M1: L1 - Option 1 Mastery" with the condition "must not be marked comp". An "Add restriction..." button is visible at the bottom of the list. Below the restrictions, the "Activity completion" section is partially visible.

Figure 7. Logic Added to Course to Create the Optional Assignment – Administrative View. The figure represents the logic that is added within Moodle to present the students with the choices. In this example, the restrictions result in the subsequent activity being unable to be viewed unless one of the choices has been selected.

## ReadSpeaker and TextAid Integration

ReadSpeaker and TextAid were added to improve the ability to address the preferred medium of communication of students. ReadSpeaker is designed to be embedded in content and provide a floating tool bar that can be activated at any time by selecting the listen button. Users have the option to have content highlighted when it is read as well as download an mp3 audio version of the content. An example is below:

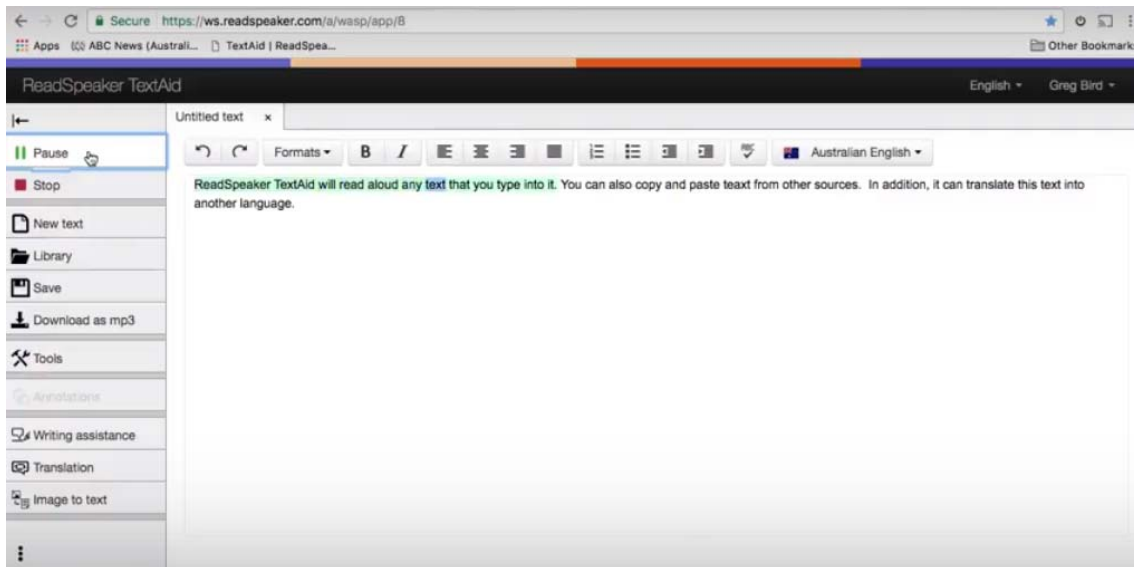


*Figure 8.* ReadSpeaker eText support tool. The figure represents an example of the ReadSpeaker interface with text and word highlighted. The ReadSpeaker toolbar also shows the ability to stop, play, adjust volume, adjust settings, and download the audio as an mp3.

TextAid provides additional reading and writing support functionality. TextAid opens web-page content in its own player and provides:

- Document Reading–View and listen to your documents in several formats (PowerPoint, PDF, Word, EPUB, etc.). Save any document to your personal library and access it from any browser or device.
- Writing Assistance– Have the text read back to you as you type. You can choose to have completed words or full sentences read. Further support for character-by-character reading is available.

- Text Selection and Lookup: Select any part of the text and listen to only that section. You can also look up the selected word or text on Wikipedia or perform a web search on Google.
- Text Settings– Customize the text display and formatting for more comfortable reading. You can choose the text color, size, and typeface, including fonts such as OpenDyslexic.
- Screen Masking– Focus on smaller parts of the text at once.
- Reading Ruler– Focus on one line at a time.
- Talking Calculator– Reads back numbers as well as calculations.
- Text Library– Save text to your personal library and retrieve it at any time.
- Translation– Translate text into any of the available languages. You can then listen to the translation or revert back to the original language.
- Reading Language and Speed– Listen to text in American, Australian and British English, German, Spanish, French, Italian, Brazilian Portuguese, Dutch, Norwegian, Finnish, or Swedish and adjust the reading speed to your comfort level.



*Figure 9.* TextAid eText support tool. The figure shows the TextAid interface with text and word highlighted. Playback, pause and stop are visible as are additional functionalities of: create a new text, add text to library, save, download as mp3, tools, writing assistance, translation, and image to text.

In order to ensure that students understood the potential of these tools, an introductory video was created as part of a required introductory multiple-choice test. Students had to mark that they had watched the video and understood what the technologies were before they could access the content of the course. An additional link to TextAid was also created in the assignment description for all mastery assignments in order to support its use in the creation of written content.

### **Pre-test, Post-test**

Each of the four modules in the English 1A course has a pre-test and a post-test. If students received a score of 80% or higher, they tested out of the modules. In the original version of the course, the pre-tests and post-tests had some variation among the questions. The course instructor and researcher standardized the test questions for the pre-test and post-tests,

developing 15 questions per test. These questions were mapped to the common core standards for English Language Arts at the 9<sup>th</sup> grade level. The questions were randomly selected from the 15 question pool using the randomization function of the quiz tool in the Learning Management System. The questions presented on the pre-test and post-test, therefore, were exactly the same, but the order in which they were presented was not. As some students tested out of the modules, the number of post-tests taken varied across the control and treatment groups. The combined pre-test, post-test scores were used to determine differences in mean test score gains across groups.

### **Comparative Achievement**

In addition to the comparison of mean test score gain differences on the pre-test and post-tests, the study used an Independent Samples T-test to examine comparative score differences on course grades, which were accumulated from scores on the mastery assignments. As not all students completed the entire online credit recovery course, completion and drop numbers were also tracked by section. Finally, for students completing the course, an Independent Samples T-test was used to compare mean score differences on the final exam.

### **Surveys**

At the end of Module 1 in the UDL treatment sections of the course, an in-course survey asked for feedback on student experiences. The survey was written from the perspective of a course instructor requesting feedback on the course experience. In order to ensure anonymity, the survey was linked to Qualtrics, a secure online survey tool that resides outside of the LMS. Students who dropped the course were also surveyed on their reason for dropping. The Personalized Learning Designer tool within the LMS was used to send an e-mail to course participants when they dropped the course. In order to ensure anonymity, the survey was also

linked to Qualtrics. It was noteworthy that previous surveys issued by the virtual school had not received high response-rates. For this reason, surveys were kept to a minimal number of questions. See Appendix A for both surveys.

### **Student and Instructor Interviews**

Four interview requests were sent to the home address of students in Fall Semester 2016. The students identified were those that used TextAid. After these initial purposive requests received no reply, an additional 10 requests were sent to other course participants who had used TextAid. The researcher sought an equal number of male and female participants. The virtual school followed up on this second request for participation with a further e-mail to participants. The researcher received no parental and student consent to conduct interviews from these requests either. The curriculum director of the school explained the lack of responsiveness in these terms: “Almost all of these students were dropped due to inactivity, so, I am not surprised that you haven't heard from them.” (J. Neiffer, personal communication, April 24, 2017).

Permission was received to interview the course instructor. An interview was conducted via Blackboard Collaborate with the course instructor on July 18, 2017. The interview was recorded and then transcribed verbatim by the researcher. The interview was semi-structured and conducted with IRB approval. The interview lasted approximately 45 minutes. Following the work of Corbin and Strauss (2015) and Miles, Huberman and Saldanna (2014), the interview was analyzed using open coding, noting relevant concepts, themes, and patterns. A coding-check was conducted by a colleague with a doctoral degree from the University of Montana. The researcher also checked his understanding of the interview with the course instructor in a follow-up email, in which instructor feedback on the UDL course features was clarified.

## Research Questions

In order to compare student achievement in the English 1A control section and the UDL treatment section, this study addressed the following primary research questions:

1. Does the inclusion of course features based on Universal Design for Learning principles (mastery assignment options in a quiz format with writing prompts, and integration of ReadSpeaker and TextAid) improve student pre-test, post-test scores in the English 1A credit recovery treatment section in comparison to the control section?
2. Does the inclusion of the course features improve course grades in the UDL treatment section of the course in comparison to the control section?
3. Does the inclusion of the course features improve course completion rates in the UDL treatment section in comparison to the control section?

The researcher was also interested in learning about the student experience in the UDL treatment section, and identifying whether the UDL course features were of particular value to participants.

A secondary research question to address the student experience was developed:

4. Do participants in the study find the inclusion of the UDL course features worthwhile?

## Hypotheses

It was hypothesized that the inclusion of the UDL course features would improve student achievement, completion rates and course grades of students in the treatment group. The null hypothesis was that there would be no experimentally important or experimentally consistent relationship between difference on achievement between the control and treatment grouping

level variables. It was also hypothesized that there would also be qualitative evidence of appreciation for the changes among the study participants.

### **Assumptions**

*A priori assumptions.* The assumption of homogeneity of variance was set at the .05 level (Levene's test). Statistical significance was set at the .05 level, and the effect size will be calculated using Cohen's (1988) guidelines for effect sizes when comparing differences between means: small = .2-.3; medium = .5; and, large = .8-1.0 (p. 25).

*Statistical assumptions.* Following Pallant (2016), three statistical assumptions are held for the analysis: 1) Independence of observation: All data points in the subset were selected independently of one another. 2) Normal distribution: The population from which the sample is taken is normally distributed. 3) Homogeneity of variance: The samples are obtained from populations with equal variances, indicated by a Levene's test score greater than .05.

### **Population**

The population came from students in grades 9-12 in a Western State in the U.S. It included students taking the English 1A credit recovery course in Fall Semester 2016 and Spring Semester 2017. 30 school principals gave their consent for students to participate in the study. Participating schools were located in both urban and rural areas in the state. Student numbers in schools ranged from 18 to 1890 students. (K-12 Public Schools & Enrollment Characteristics, 2012-13 (2018)).



## Data Collection

Data was collected on various aspects of students' participation and experience in the course. The protocols for collecting the data are outlined in the table below:

Table 1.

*Data Type, Collection Timeframe, Method, and Purpose*

Type	Timeframe	Method	Purpose
Demographic and student characteristic Information	Spring 2016, Fall 2017	Request for public data from the Office of Public Instruction on participating students in the virtual school.	Identify study participants' characteristics
Pre-test, post-test	Fall Semester 2016 – Spring Semester 2017	Learning Management System grade export	Primary data on comparative module achievement
Course progress and completion and UDL course features	Fall Semester 2016 – Spring Semester 2017	Student Information System grade export and logs.	Primary data on student progress in course, completion, course grades and final grades
Course drop Survey	Fall Semester 2016 – Spring Semester 2017: After course drop	Qualtrics survey tool	Primary data on reasons for students dropping course
eText Support Data: ReadSpeaker and TextAid	Fall Semester 2016 – Spring Semester 2017	Administrative Interface for ReadSpeaker and TextAid. csv file download	Primary data on use of ReadSpeaker and TextAid
Formative feedback survey	Fall Semester 2016 – Spring Semester 2017: After Module 1	Qualtrics survey tool	Primary data on course experience
Interviews	Fall Semester 2016 – Spring Semester 2017	Blackboard Collaborate (webconferencing system)	Understand instructor and student experiences

## Course Adjustments

In order to setup the control and treatment sections of the courses, a number of adjustments needed to be made. The following table indicates the changes that were made to the course sections in order to conduct the study:

Table 2.

### *Course Section Adjustments*

Adjustment	Section(s)	Steps	Purpose
Quiz Questions	Control and Treatment	Reviewed and edited questions with the course instructor, mapped to common core standards, included fixed questions, setup quizzes in Moodle	Make sure the control and treatment sections were being asked the same questions
Add activity completion and restrict access logic and additional mastery assignments	Treatment	Use of label and activity completion setting in Moodle to allow students to select a mastery assignment option. Use of restrict access setting to make the new mastery assignment available	Develop a pathway through the content that provided students with an option for the mastery assignment
Mastery Assignments	Treatment	Develop an alternate version of the mastery assignments using the Moodle quiz tool	Provide the alternative mastery assignment option for students
Sentence starters	Treatment	Create and add sentence starters for each of the mastery assignment questions developed in the Moodle quiz tool	Support the completion of the mastery assignment option

Integrate ReadSpeaker and TextAid	Treatment	Use of Learner Technology Interoperability (LTI) to add embedded eText support functionality	Permit use of ReadSpeaker and TextAid within Moodle.
Add Course Drop Survey	Treatment	Use of Moodlerooms Personalized Learning Designer to set trigger for automated e-mail to be sent when there is lack of login	Gather data on reasons for students dropping course
Orientation Quiz	Treatment	Inclusion of mandatory additional question in quiz with a video explaining ReadSpeaker and TextAid use	Orient users to the eText support technologies, their features and how to use them.
Closed captions	Control and Treatment	Use of Camtasia Studio to caption files, create .srt files and upload to Kaltura video repository	Caption videos
Course Survey	Treatment	Add logic to Moodle to make a survey available on completion of Module 1 and link to Qualtrics survey	Gather feedback on student experiences

### Quantitative Data Analysis

An Independent Samples T-test was used in SPSS version 24 to determine if there were statistically significant differences between the mean gain score differences in the control and treatment groups. An Independent Samples T-test is most appropriate when there is little expected impact of a covariate such as pre-test scores, and the variation among the group is equivalent (Pallant, 2016). As there was a substantial period of time and instruction between the

pre-test and the post-test and the question order on the post-test was shuffled, it was not expected that taking the pre-test would have a substantial influence on the post-test results. As students were placed into the sections randomly over a period of approximately three months, variation was also expected to be normally distributed. Histograms were used to provide insight into homogeneity of variance of pre-test scores and identify the direction of analysis. Levene's test, a robust test for measuring the homogeneity of variance between groups, was then used to establish whether the assumption of homogeneity of variance was statistically met (Levene, 1960). In order to further identify the group compositions, gender, GPA scores, grade level, disability, limited English proficiency, and eligibility for free and reduced-price lunch were identified. Course and final grade differences were also identified and statistically compared. Finally, the comparison of course drops and completions in control and treatment sections were examined as passing rates.

### **Qualitative Data Analysis**

The primary sources of data for the qualitative analysis were the responses to the in-course survey and the instructor interview. The survey was designed for students to offer formative feedback on the course experience. It included open-ended questions that solicited feedback on two items: the course features and any improvements participants would make to the course. Steps in the data analysis of the interview included providing an accurate count of the items identified by students, sorting and categorizing these items into groups, ranking the order of occurrence, and organizing the output for analysis. Inter-coder agreement was sought from a colleague with a doctoral degree and contradictions were resolved through revisiting the original

items and classifications. The survey response data was sufficiently simple for the open codes to provide the categories.

The instructor interview was recorded via a webconference call and transcribed verbatim. Following Miles, Huberman and Saldanna (2014), steps in the data analysis of the interview included: assigning codes or themes, sorting and sifting through the coded materials to identify similar phrases, patterns, themes, categories; adding reflections, and then gradually elaborating assertions, propositions and generalizations that address the consistencies in the data.

Credibility of the findings was supported through rich and meaningful descriptions, member-checking, inter-coder agreement as well as addressing any negative evidence (Miles, Huberman, & Saldanna, 2014). The analysis of the interview ultimately aimed to “ring true” (p. 313). The coding framework is presented in Appendix B.

### **Role of the Researcher**

The researcher served as a Director of Instructional Design at the time of writing and knew the administration of the virtual school through a collaborative work group on administering Moodle for our respective institutions. Familiarity with and interest in the credit recovery course design process at the virtual school led to conversations on the potential to impact the achievement and passing rates of students by incorporating Universal Design for Learning features into the virtual school’s program. At first, we were unsure whether the linear structure of the course would permit the inclusion of the assignment choices, so the researcher developed a test version of the course on a sandbox site to provide a proof of concept. When we determined that it was possible to include the mastery assignment options as well as the other

adjustments to the course, the instructional program director and curriculum director at the virtual school made the adjustments to the production version of the courses. The course instructor and the researcher also modified the quiz questions in line with common-core standards. These adjustments were again put into production by the virtual school. At no point did the researcher have access to the 'live' version of the courses where student data could be viewed. This approach was followed to minimize any potential impact on students as well as ensure the security of the student data. Therefore, with the exception of the course instructor, and individuals who were contacted for a follow-up interview, participants were not aware that the research was being conducted.

In order to seek principal assent for student data to be included in this study, the virtual school provided the researcher with a list of schools who participated in previous semesters of the English 1A course and updated the list as the terms progressed. The researcher identified the principals from school websites and e-mailed and followed up with a phone message requesting their participation. 30 out of the 36 principals contacted agreed to have their students participate in the study. In order to access the student data, the virtual school and the state Office of Public Instruction developed an agreement to share course and demographic information with the researcher based on criteria that the researcher provided. After the end of the Spring 2017 Semester, the researcher received the various data sets from the virtual school and the OPI and counted and combined course data to provide the insights outlined in this study. Based on the use of TextAid in the Fall and Spring Semesters, the researcher also reached out to the parents of students and students to seek consent for follow-up interviews. 14 interview requests were sent; none were returned. The consent letters are included in Appendix C.

For the interview process, the researcher provided an interview protocol to the instructor prior to meeting (See Appendix D). The outline explained the ethical standards by which the interview would be conducted, and also assured the interviewee that it could be stopped at any time. The semi-structured interview was designed to elicit answers on the course participants, UDL course features and the experience for the instructor. As these questions were not deemed to be overly sensitive, there was not the expectation that the interview would veer into problematic topics. However, caution was noted in the direction of the conversation all the same in order to make sure the instructor felt comfortable with the line of questions. Direct quotations were sent to the instructor and virtual school administration to check for accuracy before the study was finalized. Data was kept secure after transcription and throughout the study.

In sum, the primary role of the researcher was to demonstrate how the additional UDL course features could be implemented and develop the data gathering and collection environment that would permit the assessment of their impact. With the exception of the interview, data was gathered through external systems and provided through a secure channel after the students had exited the courses. In many ways, the researcher's role could be characterized as an adjunct the virtual school's curriculum design team. Communication was relayed through the administrative team and their existing systems so as to maintain compliance with data access policies and ensure that the virtual school maintained its positive relationships with the various districts and principals.

### **Limitations**

This study had several limitations that impacted the generalizability of the findings. First, the selection of participants into the control and treatment groups was randomized by a staff

member selecting one of the two sections for enrollment at various schools across the state of a period of several months. When one section of a course reached its capacity of 40 students, the student information system made that section closed for enrollment. Due to the numerous factors that influenced when staff members enroll students, it was anticipated that the process would result in groups that will be equal in terms of their student characteristics and enrollment numbers. However, because the randomization was not controlled by the researcher, it is more challenging to claim that the interventions definitively caused the outcomes.

Qualitative data was also limited to those who respond to the in-course formative evaluations and the request for consent to participate in the follow-up interviews. It was anticipated that this would result in limited responses to the in-course survey, and limited responses to the request to participate in follow-up interviews. The in-course survey received numerous replies, but no consent was received to interview students. This offered no opportunity for the selection of follow-up interviews, which reduced insight into the effectiveness of the course features.

### **Ethical Considerations**

The primary purpose of the research was to understand the impact of a curricular intervention. The research for this study, therefore, falls under the IRB exempt category, which generally has minimal risk to participants. Approval from the IRB to conduct the study was issued before contact was made with school principals to seek their consent for students to participate in the study, and a study extension was granted for the second year of the study. Principals were informed at that time that parent and student assent to participate in the follow-up interviews may be sought. Data was kept private and not released without consent. Identities



were kept confidential and pseudonyms used. Information linking the participant to the data was stored in a secure location with password protection. The recording of the interview was transcribed without any information that could identify the participant. After analysis, the recording was deleted.

### **Summary**

This study used an experimental approach to investigate the impact of UDL course features on student achievement in an online credit recovery course. One section of a course (the UDL treatment) was modified to include mastery assignment activity options with sentence starters and eText support technologies: ReadSpeaker and TextAid. The impact was measured using both quantitative and qualitative methods. Mean test score gains on pre-and post-test differences in the course modules, course grade scores, and final grades were analyzed as were the eText usage statistics. The student learning experience was also investigated through in course and course drop surveys as well as a follow-up interview with the course instructor. The study was conducted to high ethical standards.

## Chapter Four: Results

The primary purpose of this study was to identify whether the inclusion of certain course features based on Universal Design for Learning principles impacted student achievement in an English 1A online credit recovery course. In order to investigate this topic, a UDL treatment section and a control section were established for Fall Semester 2016 and Spring Semester 2017 English 1A courses at a statewide virtual school. Participant characteristics were identified through demographic records provided by the state Office of Public Instruction. Mean gain differences on module pre-test and post-test scores were compared across the sections over the two semesters. Course completion rates and grades were also compared across sections. Utilization of the eText support tools, ReadSpeaker and TextAid, were tracked through the administrative interfaces of the software. The student experience in the treatment section was identified through an in-course survey after Module 1, and a drop survey when students exited the course. Finally, an interview was conducted with the course instructor after the end of the Spring Semester 2017. The researcher did not receive permission to interview students.

In this chapter, the results have been organized to help the reader understand the impact of the UDL course features on achievement and participant experience. To contextualize the results, the chapter first outlines participant characteristics in the courses and the breakdown of participant characteristics by course section. The statistical impact of the course features on achievement is then calculated through an Independent Samples T-test on the mean gain score differences of module pre and post-tests. This is followed by the statistical impact of the course features on course grades and the final exam. The chapter next addresses the percentage differences in course completion rates. The use of the eText support technologies by participants

in the treatment section is then identified. The student experience in the UDL treatment section is next considered through the quantitative and qualitative findings of the in-course survey, and the final section covers the instructor's perspective on students, course features, and administration of the course.

## **Participants**

There was a total of 157 enrollments in the English 1A courses in Fall Semester 2016 and Spring Semester 2017. Of the 157 enrollments, 140 were originally identified for inclusion in the study as 30 out of 36 school principals gave their permission for the use of student data in the study. Of these 140 enrollments, eight students dropped during the grace period afforded by the virtual school (up to 22 days after enrollment). One of these students re-enrolled in the Spring Semester 2017. Students dropping during the grace period were ultimately removed from the enrollment totals as they did not provide sufficient data for the study. This resulted in a total of 133 course enrollments across the two semesters.

The 133 enrollments were by made by 118 individuals as students could enroll in the course in both semesters. Of the 15 students that enrolled twice, 7 students passed in the Spring Semester (3 in the control section, 4 in the UDL section); 8 students did not pass in either Fall or Spring Semesters. In terms of group composition, more than twice the participants were male than female: male,  $n=81$ ; female,  $n=37$ . A significant number of students received free or reduced-price lunch,  $n=72$ , or 61%. In the state, the percentage of students receiving free or reduced lunch is 44% (Common Core of Data, 2014-15 School Year). Most participants were in grade 10 of schooling,  $n=55$ , or 47%, consistent with reports made by Stevens and Frazelle (2016) on the virtual school population. The Grade Point Average (GPA) of participants was

1.64, equivalent to a 72% or a C-. 7 students were identified as having a disability. In relation to the Individuals with Disabilities Education Act (IDEA), the categories of disability were: learning disability (LD=2), multiple disabilities (MD=3), emotional disturbance (ED=1), and other health impairment (OHI=1). 2 students were identified as having limited English proficiency. A summary of the characteristics is presented in Table 3 below:

Table 3.

*Characteristics of Participants by Section\**

	Control		Treatment		Total	
	Fall 2016 <i>n</i>	Spring 2017 <i>n</i>	Fall 2016 <i>N</i>	Spring 2017 <i>N</i>	<i>n</i>	%
Enrollments	35	29	30	39	133	100%
Participants	31	26	27	34	118	100%
School Year						
Grade 9	1	8	0	11	20	17%
Grade 10	15	8	16	16	55	47%
Grade 11	13	7	6	5	31	26%
Grade 12	2	3	5	2	12	10%
Average GPA**	1.72	1.51	1.66	1.67	1.64	72% C-
Limited English	1	0	1	0	2	2%
Disability	2(MD/OHI)	2(LD/LD)	2(MD/ED)	1(MD)	7	6%
Reduced or free lunch	20	13	17	22	72	61%

\* Data was provided with support from the Statewide Longitudinal Data System at the state Office of Public Instruction

\*\* GPA scores were extracted from schools' student information systems and sent to the Office of Public Instruction on a voluntary basis. The average GPA score is based on 66/118 GPA submissions.

### **Pre-test, Post-test Score Gains**

All students taking the course must complete the pre-test for each module. If they scored 80% or higher on the pre-test, then they tested out of the module. Scores were calculated for students who scored less than 80% on pre-tests as this meant that they also received post-test scores in the modules. 16 participants tested out of 4 modules in the Fall Semester 2016 control group; 29 tested out of 4 modules in the Spring Semester 2017 control group; 10 tested out of the modules in the Fall Semester 2016 treatment group; and, 26 tested out of the modules in the Spring Semester 2017 treatment group. This resulted in a total of 83 pre-test, post-test scores in the control group across the two terms, and 104 pre-test, post-test scores in the treatment group.

Histograms of pre-test scores in the control and treatment groups were used to provide a view of the normality of the distribution. Pre-test mean scores and standard deviations were very close for the groups and provided similarly distributed values. The means of the pre-test scores in the control and treatment sections fell around the score of 6. Major peaks outside the normal range were also clustered around the score of 7. Students tested out of the module with a score of 8 (80%). Levene's test for equality of variances was also used to address the statistical homogeneity of variance. Levene's test measures the difference between each score and the mean of the group from which it came (Pallant, 2016). For Levene's test, a score of .05 or less would indicate that the assumption of homogeneity of variance was not met. As we were interested in measuring the difference in mean score gains across groups, the mean differences among participants pre-test and post-test scores were first calculated across groups, and then Levene's test was conducted on the score gain differences across groups. The results indicate that the assumption of homogeneity was met ( $F = .91, p = .34$ ).

Descriptive statistics showed a minimal difference in the mean score gain differences across groups with the control section fractionally higher:

Table 4.

*Mean Score Differences Across Groups*

	Group	N	Mean	Std. Deviation	Std. Error Mean
Difference	1	83	1.9159	1.37452	.15087
	2	104	1.8935	1.58996	.15591

The mean increase in the control group was 1.92 points from pre-test to post-test. The mean increase in the treatment group was 1.89 points. Results from the Independent Samples T-test suggest that there was no statistically significant or important differences in the increase in score gains in the control group ( $M = 1.92$ ,  $SD = 1.37$ ) over the treatment group ( $M = 1.89$ ,  $SD = 1.59$ );  $t(185) = 1.02$ ,  $p = .919$  (two-tailed). The magnitude of the difference in the means (mean difference = .03, 95% CI: -.41 to .46) was very small (eta squared = .01). A  $p$  value of 0.919 suggests that almost 92% of the differences fall within the normal expectation for the group. The effect size for this analysis ( $d = 0.01$ ) was found to be much lower than Cohen's (1988) convention for a small effect sizes ( $d = 0.2$ ). Therefore, the results indicate that individuals in the UDL treatment group ( $M = 1.89$ ,  $SD = 1.59$ ) experienced no statistically significant or important impacts on the achievement over the control group ( $M = 1.92$ ,  $SD = 1.37$ ) in their scores on module tests. It follows that the inclusion of course features based on Universal Design for Learning principles (mastery assignment options in a quiz format with writing prompts, and integration of ReadSpeaker and TextAid) did not result in any statistically significant or important differences in achievement on test scores in the treatment section.

## Course Grades

Course grades include the total scores on mastery assignments as well as grades on the final exam for participants completing the courses. The course grade totals from the mastery assignments have a cumulative score of 100. The final exam is drawn from the complete pool of questions from the module quizzes, and is based on a 25 point score. 31 students in the control section and 36 students in the treatment section received course grade totals and final exam scores across the two semesters. Descriptive statistics again showed similar mean scores across groups with the treatment section having marginally higher scores.

Table 5.

### *Mean Course Grades Across Groups*

Group	N	M	(SD)
Control	31	81.8	(3.54)
Treatment	36	83.4	(4.59)

The mean course grade score differences across sections and terms had a difference of 1.57 points. An Independent Samples T-test confirmed a lack of statistically significant difference between the control ( $M = 81.8$ ,  $SD = 3.54$ ) and the treatment group ( $M = 83.4$ ,  $SD = 4.59$ ),  $t(65) = -1.612$ ,  $p = .112$ . Levene's test for equality of variances indicated homogeneity of variance was met at  $p = .35$ .

Final exam grades also showed a similarity in scores across sections with the final exam scores being slightly higher in the treatment section:

Table 6.

*Final Exam Scores*

Group	N	M	(SD)
Control	31	19.00	(1.528)
Treatment	36	19.44	(2.063)

Again, the mean scores on the final exam in both sections were very similar. The treatment group is .044 points higher than the control group. The minimal differences in score gains do not indicate a substantial impact of being in one group or another. An Independent Samples T-test confirmed a lack of statistically significant difference between the control (M = 19, SD = 1.53) and the treatment group (M = 19.4, SD = 2.06),  $t(65) = -.99$ ,  $p = .327$ . Levene's test for equality of variances indicated homogeneity of variance was met at  $p = .19$ . It follows that the inclusion of course features based on Universal Design for Learning principles did not result in any statistically significant or important difference in achievement on course grades or the final exam score in the treatment section.

**Course Completion Rates**

Course completion rates varied in control and treatment sections over the two semesters with the treatment sections having higher completion rates in Fall Semester 2016 and Spring Semester 2017. This resulted in the treatment section having higher passing rates based on course enrollments and participants:



Table 7.

*Course Completion Rates*

	Control	Pass (n)	Pass rate	Treatment	Pass (n)	Pass rate	Totals
Total Enrollments	68	32	46%	65	35	55%	133
Total Participants	57	31	54%	61	36	59%	118

Note: percentages were rounded.

Based on the number of students who stayed enrolled in the English 1A course past the 22-day grace period, the passing rate was 9% higher in the treatment group than the control group over the two semesters. Considering individual course completions, the passing rate was 5% higher in the treatment group than the control group across the two terms. This equates to approximately 3 more students passing the class in the treatment section than the control during the study timeframe.

### Use of eText Support Tools

**ReadSpeaker.** ReadSpeaker provides text-to-speech and text-highlighting options integrated into the online course pages. As can be seen from the results below, ReadSpeaker was used by participants in every month of the study with use varying widely across months. ReadSpeaker logged use when a number of characters were selected and played back by a course participant. Individual participant use was not tracked by the tool. The table below highlights total individual use for Fall Semester 2016 and Spring Semester 2017:

Table 8.

*ReadSpeaker Individual Use Count*

Fall Semester 2016		Spring Semester 2017	
September	14	January	3
October	24	February	8
November	2	March	6
December	11	April	12
		May	10
TOTALS		51	
		39	

In Fall Semester 2016, ReadSpeaker was used 51 times, in Spring Term, 2017, it was used 39 times. However, the number of characters read with ReadSpeaker was more than 4 times higher in the Fall Term than the Spring Term:

Table 9.

*ReadSpeaker Characters Read*

Fall Semester 2016	Spring Semester 2017
276756	63554

A closer inspection of the usage locations reveal that a good many use instances occurred on the course homepage in Moodle. Fall Semester 2016 use of ReadSpeaker on the course homepage occurred in 18 out of 51 times. In Spring Semester 2017, ReadSpeaker use on the homepage was less frequent, occurring on just 4 of the 39 occasions. Other activities that ReadSpeaker was used for included: Fall Semester 2016: quizzes (7), books (7), assignments (6) and other pages (2) in Moodle. Spring Semester 2017: quizzes (3), books (10), assignments (9)

and other pages (4).

**TextAid.** TextAid is an eText reading and writing support technology that incorporates a number of reading support features. Due to the limited licenses provisioned by ReadSpeaker in Fall Semester 2016, the TextAid application was unable to be used by students in the Fall Term. Given that the researcher was unsure of the expectations for use, the issue was not corrected until late November. An additional 1000 user licenses were added in early December, but the information was insufficient to provide a picture of TextAid use in the Fall Semester 2016 term. TextAid use for Spring Semester 2017, therefore, is the only data on TextAid use that is available for this study. This represented in the table below:

Table 10.

*TextAid Character and Word Count*

Participant ID #	Jan	Feb	Mar	Apr	May	Total Character Count	Total Word Count
1		451/100				451	100
2		481/91				481	91
12	3044/650	6068/1342				9112	1992
15	451/100				12686/3004	13317	3104
18		73/17				73	17
20		451/100				451	100
24		1353/300				1353	300
TOTAL USAGE						25,689	5,804

Note. The researcher's total usage of 451/100 was removed from the participant scores, but contributes to the total usage count.

With TextAid, participant use is recorded when the TextAid application is opened. To

open TextAid, participants click on a Learner Technology Interoperability (LTI) link that was featured prominently on the site and in the assignment area. A total of 24 users used the TextAid LTI in Spring Semester 2017. Of those 24, 17 went no further than opening the application. A recording of a character count of 451/100 represents a test of whether the tool is working, and so is indicative of minimal use of the system. Most of the other 7 participants, therefore, only used the service minimally as their usage is around this range. Participant 12 and participant 15 appeared to use the system more frequently to support their writing across the term. The pattern of use for participant 12 differed greatly from participant 15. TextAid was used by participant 12 extensively at the start of the term, and then ceased to be used later in the semester. In contrast, participant 15 briefly in the early part of the term and then extensively at the end of term. TextAid was not used at all during the month of March and had inconsequential use in April. This can be explained in part by March being the primary month for Spring Break in High Schools in the region. TextAid's administrative interface identified participant names and the researcher used these to identify individuals to be contacted for follow-up interviews. No responses to the interview requests were received.

### **Student Experience**

The study employed two survey tools to capture student feedback in the UDL section of the course. The first survey was delivered in an e-mail to students who dropped the course. A trigger was established with the Personalized Learning Designer (PLD) tool within Moodle to issue an e-mail that included the drop survey when a student was dropped from the course. A total of 48 students dropped the English 1A credit recovery course in Fall Semester 2016 and Spring Semester 2017 including those dropping during the grace period. Of those that received

the survey, only one response was returned, and it was blank. After discussion with the curriculum director at the virtual school, the lack of results were thought to indicate the challenge of having students check and respond via their school e-mail accounts as well as the tendency of the credit recovery population, especially those who drop, to be unlikely to engage in further feedback with the school.

The second survey was built into the structure of the English 1A treatment section, and was written in such a way as to elicit feedback that could be used to improve the course experience in future courses. After completion of the last assignment in Module 1, the participants had to click on the link to the survey before they could progress to the next section. Clicking the link was the only requirement that could be enforced through the software. This resulted in 46 out of a possible 61 responses in the UDL treatment sections in the Fall and Spring Semesters, or a 75% response rate. This is generally considered to be an adequate response rate in survey based research (Gay, Mills, & Airasian, 2012). The survey asked students to rank their thoughts about the course on a scale of 1-100, and asked open-ended questions on the courses experience (See Appendix A). The quantitative responses are represented in the table below:

Table 11.

*Survey Grading Scale Responses*

Question	Minimum	Maximum	Mean	Std.Deviation	Count
I feel I am learning a lot in this course	0	100	70.13	27.17	46
I find the course challenging	0	100	66.63	32.65	46
I find the course easy to navigate	0	100	74.38	29.15	46

I am satisfied with the learning experience	0	100	73.06	29.16	46
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Slightly over 70% of respondents indicated that they were learning a lot, and 73% indicated satisfaction with the experience. However, only 67% of respondents indicated that they found the course challenging.

The second part of the survey asked several open-ended questions of participants. A number of steps, drawn from the work of Saldanna, Miles and Huberman (2014), were followed to ensure the fidelity of these results. Using a template developed by the researcher, the frequency with which the course features described were independently coded by the researcher and a colleague, who holds a doctoral degree (See Appendix B). Agreement in coding was then checked by the researcher and coder to ensure inter-rater reliability. There was substantial agreement on the codes as the information was not overly complex. When questions did arise on the coding, such as the count for the number of times that choices were identified, the researcher and inter-rater checked and confirmed the correct coding and count for the items identified. The coded results from the survey are presented below, and ranked by their frequency of occurrence.

Table 12.

*Participant Ranking of Useful Course Features*

Feature	Most Frequent (Rank)	Count
Access to support/help	1.	11
Videos	2.	6
Ease of navigation	3.	5
Mastery assignment choices	4.	3
Don't know	4.	3
Everything is good	4.	3

Online/computer-based	4.	3
Prezzies	5.	2
Clear instructions	5.	2
Nothing helpful/Dislike course	5.	2
Completion activity information	6.	1
I-search paper (assignment)	6.	1
Doop detector (assignment)	6.	1
Pre-assessments	6.	1
Need more time to do work	6.	1
No need to talk to anyone	6.	1

The survey also provided an opportunity for participants to identify what they thought might make the course better. This is presented in the table below:

Table 13.

*Ranking of Course Improvements*

Feature	Most Frequent (Rank)	Count
I don't know	1.	6
Nothing, the course is fine	2.	5
Clearer instructions, better definition and explanations	2.	5
More/improved teacher interaction	3.	3
Individualized activities/ More personalization	4.	2
Easier quizzes	4.	2
Less course work/ modules	4.	2
Less writing assignments	4.	2
Less wait time between quiz attempts.	5.	1
Less typing.	5.	1
Less research.	5.	1
Better writing tools (not Word).	5.	1
More information on subjects.	5.	1
More pictures and visuals.	5.	1
More interesting readings.	5.	1

More rubrics.	5.	1
More layout plans.	5.	1
More freedom.	5.	1
Easier navigation.	5.	1
Learning material be the same as it is in the regular English class	5.	1
Not the same learning material as the English II class.	5.	1
Easier to save your progress.	5.	1
Able to do more of the course at home.	5.	1

The suggestions for what to do to make the course better are noteworthy in range and insight. Taking into account students who did not have anything to suggest (n=6) and those who thought the course was fine (n=5), we again see the importance of clear explanations and guidelines (n=5) as well as the importance of instructor feedback (n=3). It is also noteworthy that two participants identified the need for individualized activities and more personalization, and another participant noted the need for more freedom in the course. Participants also identified several additions to the course that would improve the experience: more pictures and visuals, more interesting readings, more rubrics and more organizers (layout plans). Some suggestions were in response to issues with the tools provided: better software than Microsoft Word, improve the ease of saving progress, adjust the 30 minute wait time between quiz attempts. Others took issue with the content, suggesting it be the same as it would be in the regular English 1A course, or be different from the English II course work. Finally, one student preferred to be able to do more of the course work at home.



### **Instructor Experience**

The course instructor was interviewed on Tuesday, July 18 at 1.30PM via a web conferencing tool, Blackboard Collaborate. The recording was transcribed verbatim and preliminary codes were first identified. This was followed by a second read-through that highlighted key ideas and noted possible categories. The accuracy of the coding was verified by an independent coding of the interview by a colleague at the University of Montana with a doctoral degree. Where discrepancies occurred in the interpretation of the codes, the coders discussed their understandings and came to a shared understanding of the instructor's response. In reading the interview through, the researcher had further questions about the instructor's response. The researcher clarified this understanding in a follow up e-mail on August 28, 2017. This process of coding, independent verification of understandings and member-checking with the research participant is in line with recommendations for qualitative coding and analysis by Corbin and Strauss (2015) and Miles, Huberman, and Saldanna (2014). The instructor's perspective on student characteristics, UDL course features, and administration of the course is presented below.

The instructor's responses clarified a number of students' characteristics in the course. In line with the demographic information provided by the Office of Public Instruction, the instructor noted that the "make-up of the student was similar in both classes." In fact, she could not typically discern which section of the course the student came from as she was grading. Although the instructor noted that although the internal composition of the groups were similar, she observed that the student characteristics of credit recovery students are commonly different from students in regular classes. They may struggle with technology more than other students.

They have less confidence in their skills, and have a history of not doing well in courses. They may have a lot of distraction in their lives or have work and family commitments that affect their focus on learning. The instructor also noted the importance of local supports for students given the factors that affect their success. As she observed:

The ones that have a tendency to be less successful are the ones that have very limited support, or no support at their local site. I know the ones that do better have someone in the school or at home who is regularly checking in on them and making sure they're making progress.

For the credit recovery population in general, the instructor thought that a mastery-based approach was particularly beneficial. The course “actually pushes them to learn something in ways that other models I've seen, both in schools and online, don't. I appreciate the fact that they have to show some understanding of the concepts before they can move on.” The instructor did note that some students appreciate this approach more than others and that depended on personal factors as well as the extent of local support.

The UDL course features were generally seen as favorable by the course instructor. The instructor's positivity appeared to be generally aligned with her own personal feelings toward having multiple ways of promoting student engagement:

I look for something like that in my own courses all the time because I know the students that I'm dealing with, and have seen them face to face. I know some of them need and want that, and will reach for that if they have an opportunity. I think anytime they have that option to go that route, that's a great feature for them to have.

The instructor thought the inclusion of course captions was necessary and useful. The instructor also thought that the sentence starters were particularly important for student writing. They helped student clarify their understanding of the assignment expectations as well improve the quality of the response: “for this particular type of student, their natural response in some of these questions is to say ‘yes because,’ which I hate as an English teacher because they've missed that opportunity to learn how they phrase their answers.” The instructor was not aware of how the eText support tools were used in the course. The administrative interface for these tools was only available to the researcher, and the instructor-student communication was primarily conducted via phone, e-mail or through feedback provided in the LMS. There was no need, therefore, for the instructor to view the tools within the LMS.

In terms of course administration, the instructor experienced the most challenge with getting acquainted with how the mastery assignment choices impacted her grading process and the type of feedback she was accustomed to give. The process of grading placed a burden on her time as she needed to go into each of the quiz questions to provide feedback. As the instructor phrased it:

There was an issue of time for me. Scoring a writing with a rubric might normally take me 5 or 10 minutes tops. Where if I had to do individual quiz questions and had to score the same assignment that oftentimes took me longer. Also, the feedback is sometimes trickier because the students don't necessarily look at the individual questions.

The feedback process also required the instructor to make adjustments to how the questions were evaluated. The instructor had previously relied on rubrics that gave a certain score for written mechanics.

I had to adjust on that once I realized that. For example, the written assignment might have a built in 10 points for conventions. When I went to score the individual quiz questions, I might take a point off of each question for conventions because the question wasn't answered very well as far as sentence structure and all those things, but by the time you add those up over the quiz questions, it was probably more than what I would have done for the overall assignment. Like I said, I did catch on to that early enough that I made some adjustments just in my own grading.

While the changes were “initially the most challenging thing,” the instructor also saw some potential benefits to providing feedback at the question level: “I think there's probably a benefit to me to be grading those individual elements because it really forces me to break down what it is I'm looking for when I'm looking at it holistically.”

### **Summary**

This chapter outlined the impact of the UDL course features in relation to the four major research questions of the study: how the UDL features impacted pre-test, post-test scores on the module quizzes, how the course features impacted course grades, how the course features impacted completion rates, and the impact on the participant experience. The study found no statistically significant or important impact on student achievement from the inclusion of the UDL course features. However, an average 9% increase in enrollment completions and 5% increase in individual completions was noted in the treatment section. The eText Support tools had limited and sporadic use across the terms implemented, with two students using TextAid in a more substantial way. Some students identified the value of the inclusion of the alternative assignment choice, but none identified the value of ReadSpeaker and TextAid. The instructor

appreciated the inclusion of the UDL course features in general, and found the inclusion of the sentence starters to be impactful in terms of student performance. The quiz assignment added additional time and thought to her grading practices. The following chapter will review and discuss these results.

## **Chapter Five: Discussion**

This chapter summarizes the results of the impact of the UDL course features on student achievement in the English 1A credit recovery course. The results are then discussed in relation to the primary research questions of the study: the impact on achievement of the UDL course features, passing rates and the participant experience. Limitations of the study are highlighted, and implications for further research noted. The chapter concludes with some practical suggestions on implementing UDL course features based on the current experience.

### **Summary of Results**

This experimental study investigated the impact of UDL course features on student achievement in an English online credit recovery course in Fall Semester 2016 and Spring Semester 2017. Achievement was measured through a comparison of mean gain differences on pre-test, post-test scores as well as through a comparison of course grades, and final exam grades. Passing rates were also compared across sections. The course experience for students and the course instructor were considered from responses to surveys and an instructor interview. The course drop survey did not provide additional qualitative data, and no permission was granted to conduct follow-up interviews with students.

Demographic data from the Office of Public Instruction indicated a population with a higher ratio of male to female participants (approximately 2:1) as well as a high number of students on free or reduced-price lunch (61%), which was 17% above the state average (Common Core of Data, 2014-15 School Year). Seven students taking the course had an identified disability (5%) and two students had limited English proficiency (2%). The average GPA of the credit recovery students was a C-, or 72%. The composition of the control and

treatment groups was shown to have equivalence in pre-test score variance, as well as in demographic composition. The high number of male students and those on free and reduced-priced lunch is notably different from the demographic compositions in typical supplemental online courses (Liu & Cavanaugh, 2012; Chingos & Schwerdt, 2014). The inclusion of GPA and course drop data also provided additional data points not always included in the literature (Hughes et al., 2007).

The results of the mean score gain differences in the pre-test, post scores of modules indicated no statistically significant or important differences in mean score gains in the treatment group ( $M = 1.89$ ,  $SD = 1.59$ ),  $t(185) = 1.02$ ,  $p = .919$ ,  $d = .01$  over the control group ( $M = 1.92$ ,  $SD = 1.37$ ). Similarly, the Independent Samples T-test scores of course grades and final exam scores showed no statistically significant or important differences across groups; course grades: ( $M = 81.8$ ,  $SD = 3.54$ ),  $t(65) = -1.612$ ,  $p = .112$ ; final exam scores ( $M = 19.4$ ,  $SD = 2.06$ ),  $t(65) = -.99$ ,  $p = .327$ . The inclusion of the mastery assignments with writing prompts as well as the integration of ReadSpeaker and TextAid, therefore, had no statistically significant impact on achievement in the course. Based on enrollments, passing rates were 9% (55%-46%) higher in the UDL treatment section of the course. Based on individual participation, passing rates were 5% (59%-54%) higher in the UDL treatment section of the course. 3 students identified the choice of mastery assignment as a beneficial course feature. The instructor was also favorably disposed toward the inclusion of the UDL course features, although the addition of the quiz assignment type caused some initial challenges with grading practices.

### **Questions Raised by the Findings**

While the professional literature has advocated for a non-prescriptive and incremental approach to including UDL course features in courses (Rao, 2013; Tobin, 2014), the impact of

the specific UDL course features on achievement has had limited investigation to date.

Evaluating the lack of impact of the current course features on achievement, therefore, involves considering several possible explanations and gradations within: Were the particular UDL course features responsible for the lack of impact? Did issues with the implementation and functionality of the tools potentially limit their impact? And, would more substantive changes to the course design make a greater impact on student achievement? We will explore these questions in turn.

### **Impact of the UDL Course Features**

A closer inspection of the course features and their usage may help illustrate the potential limitations on performance impact. Fall Semester 2016 use of ReadSpeaker on the course homepage occurred 18 out of 51 times. Use of ReadSpeaker on the homepage of the course is more likely to be exploratory than it is to provide reading support given that the content primarily resides in ‘books’, ‘assignments’, and ‘quizzes’ in the course. In Spring Semester 2017, ReadSpeaker was used less frequently on the homepage, 4 out of 39 occasions. However, the actual number of characters read by ReadSpeaker use was over four times less in Spring Semester 2017 than in Fall Semester 2016. In Fall Semester 2016, ReadSpeaker was used in quizzes (7), books (7), assignments (6) and other pages (2). In Spring Semester 2017, ReadSpeaker was used in quizzes (3), books (10), assignments (9) and other pages (4). As ReadSpeaker did not provide information on individual use of the tool, it is difficult to determine the impact of using ReadSpeaker for students in these activities, but its limited use in key content areas is suggestive of its lack of potential to influence achievement across the group. While limited, however, the usage might also suggest that some users found value in using ReadSpeaker on certain occasions.



TextAid demonstrated infrequent use by all but two participants in the Spring Semester 2017 term. Participant 12 used the tool extensively in January and February, and then never used the tool again. Participant 12 was in grade 10 of a rural school district, and passed the course. He qualified for free and reduced-priced lunch and had a grade point average of 2.0 (C). He did not have limited English proficiency or an identified disability. His pattern of use suggests curiosity with the tool, and perhaps some identified benefits, but it was clearly not an important aspect of his success as he did not use it for the last three months of the course and managed to pass without the further use. Participant 12 was contacted for a follow-up interview, but did not respond to the request.

Participant 15 was in grade 10 at an urban school district, and did not pass the course. No GPA score was available from the OPI. He did not have limited English proficiency or an identified disability. Participant 15 made it just past half-way through the course. The last assignment was attempted in May, which coincided with the most substantial use of TextAid by any participant. This may suggest that the student was struggling to compose an answer and used the software to try to help, but eventually gave up. An alternative possibility might be that the use represents an ultimate lack of interest in completing the course, and a choice to spend time playing with the tool rather than completing the assignment. Participant 15 was not contacted for a follow-up interview as consent requests were sent in April, which was before his extensive use of TextAid. Taken together, and without an opportunity for further insight into the participants' use of the tools, the pattern of use for even the two most extensive users of TextAid is not indicative of a substantial impact on achievement. As others used the tool minimally, we might expect little to no discernible impact of the use of TextAid on achievement.

The mastery assignment choices were built into the framework of the course and so use of this UDL course feature was not optional. While three participants in the treatment section identified the value of the mastery assignments, the importance of help and support from the course instructor or mentor was identified with much greater frequency (n=11). Similarly, two participants identified the value of more freedom and personalization in the course, but this was fewer again than those who would like to see clearer instructions and better definitions and explanations (n=5). The inclusion of the mastery assignment choices, therefore, may simply not be as impactful as personal contact, good organization and clear directions. The literature broadly supports the importance of instructor presence and good organization (Adelstein & Barbour, 2016; Swan, 2003). The importance of the support services and instructor attention has also been well-noted in the K-12 online literature (Archambault et al, 2010; Lewis, Whiteside, & Garrett-Dickers, 2015). The value of individuals supporting students with their online learning was further corroborated by the instructor's comments on the importance of local support.

Another factor that may impact the influence of the mastery assignment choices on achievement is the individual regard for the options available. While choices have been associated with increased motivation, and there is some evidence to support the value of their inclusion in this context, the impact of choice on motivation and achievement may not always be positive. Factors such as the individual preferences for the choices, motivation, expected outcomes, and understanding of self-efficacy can all play a role in moderating the influence of the choices on learning (Bambara, Ager and Koger, 1994; Killu, Clare, & Im, 1999; Caygill & Eley, 2001; Patall, 2012). In other words, the impact on achievement may be moderated by the individual making the choices, and so impact may be more pronounced among those who appreciate the choices. Given the comparatively limited number of those identifying the value of

the choices, we may again conclude that the features are likely to have limited overall impact on achievement.

Sentence starters were not identified by students as beneficial, although the instructor thought highly of their inclusion. As she noted in the interview:

I think those were really helpful. So they knew the direction they were supposed to go with their answer. The expectations were a little bit more clear in some of the quiz questions, versus here's your writing assignment write this paragraph or whatever it may be. Then they were left to figure it out. I think that was helpful.

Students may not have seen sentence starters as an obvious 'course feature' as they may have appeared as part of the framework of the course. The sentence starters were also only available in the quiz mastery assignments, which means that not all participants in the treatment section of the course would have received their potential benefits.

Given the limited overall use of the eText course features, the less well-noted and potentially moderated impact of the assignment choices, and the availability of the sentence starters only in the additional mastery assignment option, we can perhaps understand why the inclusion of the current UDL course features were not sufficient to influence achievement across the entire treatment group. However, other possible explanations exist for the lack of impact as well.

First, it may be the case that a preponderance of existing effective course features limited the impact of the additional course features. As noted in the introduction to this study, the virtual school's credit recovery courses were adapted to the local context from North Carolina Virtual Public Schools courses, and already incorporated a number of best practices in online course

design that overlap with UDL course features. Some examples of pre-existing course features that could be classified within the UDL framework include: a course path guide in the introductory section (3.3); the identification of common core standards at the start of each module (8.1); the inclusion of multiple media types (2.5); remediation activities for those struggling with the initial content (5.3); activity planners and guides (6.1); and the use of rubrics to guide self-assessment (9.3). We might expect a course with many best practices and additional UDL course features to provide a better learning experience than a course that is not based on best practices at all, but when the course is well-developed to begin with the impact of the additional features may not be as pronounced.

Another possible reason for the lack of impact may also lie in the sensitivity of the pre-test, post-test quizzes, course grades and final exam in measuring achievement differences. It may be the case that the impact of the UDL course features could not be adequately detected using the pre-test, post-test methodology and grade comparisons. The pre-test, post-tests each had 15 questions. However, not all students completed all 60 questions as they could test out of some of the modules. It is possible that the lack of comparable mean score differences meant that the impact of the UDL differences was difficult to determine. Another potential issue is illustrated by the course grade comparison process. As we were considering the differences in score gains among students who ultimately passed the course, the differences in mean scores may not be so great as the completing students would typically be the strongest. If we were to consider the differences in score gains among those who passed and those who failed, then the results may be more pronounced. However, it would be difficult to say whether this would be due to the impact of the course features or other personal and environmental factors that could

influence achievement. Such a comparative data set would also be limited to those who at least completed the first module quiz.

In sum, there are multiple factors in relation to the course features that may have influenced the identified impact on achievement: the limited use of certain features across the group, the moderated impact of the assignment choices based on individual preferences, the limited availability of the sentence starters, the substantial baseline of existing UDL course features, and potential limitations with the comparative data-sets used in the analysis. To return to the question of whether these particular UDL course features were responsible for the lack of impact, the answer seems likely to be greatly influenced by the factors that impact uptake and use. Additional factors that may influence usage also include how well the functionality of the tools were explained and made accessible to users as well as whether the tools themselves were found to be helpful in the context they were being applied.

### **Implementation of the Features**

In the current context, there was a single location where participants were shown how to use the eText support tools: in the mandatory online orientation in week 1. While the mandatory video tutorial was required to be accessed by students in the course, the actual viewing of the video could not be made mandatory due to the inability to force viewing with the video playback. Questions remain, therefore, as to how many students carefully viewed the overview video. This may be improved by requiring students to complete a task to demonstrate their understanding of the eText support tools. For example, students could be asked to compose a response in TextAid, and paste this into the mandatory quiz before progressing. This requirement could include guidance on accessing some of the TextAid tools such as written text highlighting or setting the read back speed. Providing an alternative format for the information might also be

helpful for students. For instance, a text and image-based guide to the tools could be made available as a resource on the course homepage that could be accessed at any time.

As the video was located in the opening week of the course, it may also be the case that as time-passed participants did not remember the functionality that the tools afforded. Including further supports for the tools during the course may better support their ongoing use. Embedded performance supports hold as their basic premise the ability to: “generate performance and learning at the moment of need, while assisting in building the knowledge infrastructure for work that will be done in the future” (Northrup, 2001, p. 36). In an experimental study of University students on whether students benefitted from embedded performance supports, Clarebout, Horz, Schnotz, and Elen (2010) identified clear evidence that: “learners use support devices significantly less when they are not embedded” (p. 584). ReadSpeaker was available as a plugin on the main course page, and whenever text was highlighted, a ReadSpeaker pop-up would appear. This closely fits the embedded performance support model. TextAid, however, was only able to be accessed through clicking a link that opened up the writing support interface. The links were added to all assignment options in the treatment section of the course, but the integration of TextAid could be improved with a deeper integration within the Learning Management System. It is worth noting that such an integration would likely be challenging in certain contexts as many hosted LMS providers, such as Moodlerooms, require a code review for the adoption of new functionality. This can be time-consuming and expensive for the school, and may be an integration that the company is not willing to make. Given the in-person support that exists at the schools, an approach more likely to succeed would be to train the local support to recommend the use of the tools when the students appear to need their functionality.

As a tool, the functionality of TextAid was also limited. TextAid required text to be copied and pasted into its interface, or content to be typed directly into it. The work could be saved in TextAid, but could not be exported out of the software to a Word document or other format. Therefore, it was necessary for students to copy their work when the application was open, and then post it into the assignment in Moodle. This requires a level of commitment to using the tool that is likely higher, for many, than its perceived benefits. Rather than copying and pasting content both in and out of the application, having the ability to upload a Word document into TextAid as well as being able to export a document from TextAid to Word would have been helpful. A deeper integration within the LMS would also have provided a better option for submitting assignments. A technical support representative for ReadSpeaker informed the researcher that the option to upload and download with Word content is in their roadmap for development, but this was not an option for students enrolled in the treatment section of the course during this study.


### **More Substantive UDL-based Changes**

Given the limited impacts of the additional course features, it seems reasonable that incorporating more comprehensive design changes would make a more substantial impact on learning. As noted by Burgstahler (2013), applications of Universal Design in Education can encompass instruction, services, information technology and physical spaces. As we also consider the need to train local support in recommending the use of the course technologies, expanding the training to include the UDL focus on supporting diverse learners would likely provide more positive results. This might also help address the substantial variance in the degree

and quality of support provided by various schools in the district (J. Neiffer, personal communication, December 17, 2015).

It is clear, however, that the practicalities of applying the UDL framework beyond course design must also be considered. The UDL adjustments that were made to the English 1A course suited the model that was in use by the virtual school. The model has had numerous iterations and undergone extensive testing by the virtual school. The passing rate for students had been shown to be at the high end of the range found in prior studies of online classes, according to Blazer (2009, as cited in Stevens and Frazelle, 2017, p. 5). When a successful model exists, it may not be desirable to pursue a wholesale change of the course framework without evidence to support the changes. Moreover, what appear to be small adjustments to a course can require substantial work on a program that administers hundreds of courses. In the current case, the inclusion of the eText Support tools were relatively straightforward, but the logic that was needed to create the choices in Moodle became quite complex. An example of the ‘Restrict Access’ logic to permit the course to display assignment choices is presented below:



 Module 1 Study Guide for Post Assessment

**Restricted** Not available (hidden) unless any of:

- All of:
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 1 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 1 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**
- All of:
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Option 2 Mastery Assignment 2**
  - You achieve a required score in **M1: L2 - Option 2 Mastery Assignment 1**
  - You achieve a required score in **M1: L1 - Quiz**
  - You achieve a required score in **M1: L2 - Quiz**

*Figure 10.* Moodle Restrict Access Logic to Permit Assignment Choices. The image represents all the possible pathways that a student could follow in order to make the final exam study guide available for Module 1.

As new course content is not made available until a previous item has been successfully completed at the 80% level, introducing mastery assignment choice meant that the various permutations for successful completion had to be accounted for in the restrict access logic. What appears to be a simple choice for students, therefore, required a substantial increase in administrative work on creating restrictions based on the grade criteria being met. Extrapolating the impact of seemingly minor adjustments to a program level re-design requires the consideration of existing program demands and the practicality of implementing the changes. More positive results may come from a more substantial course re-design and the training of staff based on the UDL framework, but it needs to be married with the administrative realities of the school.

### **Passing Rates**

The rate of course completion is one of the more notable differences between control and treatment sections. The enrollment passing rate was 9% higher (55%- 46%) and the individual passing rate was 5% higher (59%-54%) in the treatment group across the two terms. Given the passing rate's translation into actual students recovering the credits they need to graduate, it is worth exploring some possible explanations of the differences in passing rates among the participants.

The GPA of the control group in Spring Semester 2017 was slightly lower (1.51, 70% C-) than the treatment group (1.67, 72% C-). However, this is offset by a higher GPA in the Fall Term for the control group. When GPA's are averaged for the groups, there is only eight tenths of a point score difference between the control (1.62) and treatment groups (1.7), which equates to less than a percentage point difference between a GPA of 71% (C-) and 72% (C-). It seems

unlikely, therefore, that GPA differences can account for the differences in passing rate. Male and female students also had the same overall passing rates (57%). However, passing students of both genders were found slightly more often in the treatment groups: 54% of passing males were in treatment groups and 52% of passing females were in the treatment groups. Students who were free and reduced-priced lunch eligible also had equivalent overall passing rates (57%). More students who did not qualify for free and reduced-priced lunch passed in the control group (n=16) than the treatment group (n=10). However, among those who were classified as eligible for free and reduced-priced lunch, more students in the treatment section (n=26) passed than in the control section (n=15). The overall passing rate for those who were free and reduced-priced lunch eligible was 67% in the treatment section, and 45% in the control section. Of the two students identified as limited English proficient, the one student who passed was in the treatment section. Of the 7 students who were identified with an IDEA disability flag, 3 students passed the course (43%). 2 of these students were in the treatment section, and 1 student was in the control section. This breakdown of passing rate by demographic subgroups points to minor differences across groups that are difficult to attribute to grouping within the control and treatment groups. However, it does suggest that students with diverse personal characteristics can have similar levels of success in an online credit recovery course, which has been a concern of researchers in the field (Barbour, 2015). For example, the passing rate for students on free and reduced-price lunch is noteworthy as is the success of three students with disabilities. Based on their IDEA classification, the three students who passed were identified as having a learning disability, multiple disabilities and emotional disturbance. While it is difficult to gauge the exact disability from these classifications, the spread across multiple categories again suggests the potential to serve diverse individuals.

Another potential impact on passing rates was the pattern of students dropping and re-enrolling in a subsequent semester. 15 students dropped the course in Fall Semester 2016, and re-took it again in the Spring Semester 2017. Of these 15 students, 11 students were in the control section, and 4 were in the treatment section. The 11 students in the control section enrolled in both control (n=5) and treatment sections (n=6) in Spring Semester 2017. Of the 5 students that re-enrolled in the Spring Semester 2017 control section, 3 students passed the course. Of the 6 students that re-enrolled in Spring Semester 2017 treatment section, 4 students passed the course. Therefore, only 1 more student passed in the treatment section than in the control section of those that re-enrolled from the Fall Semester 2016 control section. Again, this does not suggest an impact on the overall passing rate that could be attributed to a placement in the treatment section.

Given that demographics and re-enrollment patterns do not seem to have a substantial influence on passing rates, it is worth considering the passing rates by grouping for students whose schools do not perform as well as others. There were four schools where students had a passing rate less than 50%. Two of these schools only had one student who enrolled. Given that the average passing rate for individuals was around 57%, the 0% passing rate might just be due to the single enrollment. However, the other two schools had enrollments of 5 and 8 students, and passing rates of 0% and 13% respectively. The school with 5 enrollments had 2 students in the control section and 3 students in the treatment section. The school with 7 enrollments had 2 students in the control section, and 5 students in the treatment section. Based on the fact the majority of students are in the treatment sections, it is clear that the overall passing rate does not appear to be affected by a preponderance of treatment placements for students in lower achieving schools.

However, the poor passing rates for the two schools are worth a closer investigation, especially as a third school with 6 enrollments (3 in the control and 3 in the treatment section) managed to achieve a 100% passing rate. A close comparison of these three schools also reveals the following demographic composition:

Table 14.

*Comparison of Passing Rates of 3 Schools*

School	District population*	Student Grade Level	Gender	GPA (avg.)	Free and Reduced-Price Lunch	Disability	Limited English Proficiency	Pass Rate
1	11,122	G9: 1 G10: 2 G11: 1 G12: 1	4M 1F	.9	3	1	0	0%
2	11,105	G9: 3 G10: 5	5M 3F	No data	4	0	1	13%
3	12,795	G9: 2 G10: 1 G11: 3	5M 1F	1.83	5	0	0	100%

Note. \*District population based on Census 2010 total population (2018).

School 3 has more students who are identified as free and reduced-priced lunch eligible than the other schools, but has no students with an identified disability or limited English proficiency. The average GPA is almost double that reported for school 1. While these individual characteristics and reported GPA scores may influence performance, the overall similarities in demographics suggest that there may be differences with the instructional support environment between School 3 and Schools 1 and 2. A follow up conversation with curriculum director of the virtual school suggested a range of in-school supports across schools. School that had a high level of support generally have a teacher, administrator, or paraprofessional monitoring daily

progress, encouraging students to continue with the course work, supporting when students are struggling, and connecting students to local and virtual school's support resources. Schools with low levels of support may only provide supervision of the tests and assignment submissions. The curriculum director estimated the difference in impact in these terms: "When we first started in 2011, we did have some unofficial data that suggested that the difference between low-end and high-end support meant a passage rate of [approximately] 20% vs. 60-70%." (J. Neiffer, personal communication, February 25, 2018). A difference in passing rate of 40-50% would explain the passing rate difference for schools 1 and 2 in comparison to School 3. This is clearly an area worth further investigation by the virtual school. More generally, it provides further support for the idea of expanding the focus of UDL-based course changes to include the local support in schools.

### **Student Experience**

The quantitative findings from the in-course survey support the fact that a number of students are having success in the course. Over 70% of the 46 respondents, reported that they were learning a lot in the course, found it easy to navigate, and were satisfied with the learning experience. Only 67% of respondents found the course challenging. This may, in part, be due to the majority of students being enrolled in grades 10 and 11, which means that they would have had exposure to similar course content previously. This is also corroborated in the survey comments that request more interesting readings as well as content that they have not seen in another class. The ability to navigate the course was rated most highly with 74% of respondents noting that that they found the course easy to navigate. This may be attributed, in part, to a consistent course format across all virtual school courses (a number of students take several

online courses through the virtual school). The linear navigation structure, which permits one assignment at a time to be worked on until mastery has been achieved at the 80% level, may also contribute to the positive comments on the ease of navigation. The instructor also noted that this was one of the areas that likely benefitted students greatly. When asked what aspects of the course the students found particularly helpful, she answered:

I think for most of them the fact that the course is linear in its setup. They do one thing and they have to master that before they move on to the next thing... In my experience with this type of student, the more you can break it down into smaller pieces the better and more comfortable they feel.

The second part of the survey asked several open-ended questions of participants. Many of the course features identified and ranked highly are ones we might expect from effective online courses as noted in the literature (Archambault et al. 2010): access to support in the form of a course mentor, instructor, or technical support; clear navigation and instructions, and the use of media content such as video and prezies. Several participants did not think they had anything to say on the course experience, but overall more students thought the course was ‘good’ rather than ‘bad’, which aligns with the results from the quantitative aspect of the survey. A number of beneficial individual assignments and activities were also identified as well as certain personal preferences associated with the course experience. Of the UDL course features that were added, the mastery assignment options ranked as the fourth most appreciated feature identified. The identification of the mastery assignment choices is notable, and may be based on previous exposure to virtual school courses where the option was not available. It may also suggest that some students are looking for a more personalized approach when engaging with course content.

This is corroborated by two of the students' comments in the course survey in which they noted the desire for more personalization of content and the ability to follow individualized pathways. ReadSpeaker and TextAid were not identified among the helpful course features.

The importance of personal support by the instructor and local support also came to the fore in the survey results. The instructor, course mentor, and technical support were identified as the most appreciated factors in the qualitative responses to the in-course survey. This supports the substantial literature on the importance of the support structures for students recovering credit online (Archambault et al., 2010; Lewis, Whiteside, & Garrett-Dickers, 2015; Roblyer & Marshall, 2002; Stevens & Frazelle, 2016). Commenting on the student experience of using the course technology, the instructor also noted the importance of the adult members in the school:

With the credit recovery students, I think the local support is a huge piece of the success as far as technology goes, especially if this is a first time course for them to take in this setting. They need that initial support... They want to make sure they have an interaction with a person.

There were also students who noted that the course could be improved with further opportunities to interact with the instructor and local support (n=3). This was the third most highly ranked item identified among the ways to improve the course experience. This may again point to the differing support experiences students receive in different school contexts.

The survey also highlighted what students thought might make the course experience better. Many of the suggestions have merit in their own right, and may benefit the course experience overall. For example, there would be benefit in reviewing the instructions and



guidance provided in the course to make sure that students are understanding the task at hand. The instructor noted that the inclusion of sentence starters helped in this regard, and these should be extended to the other assignment choice in future versions of the course. Adding additional rubrics, alternative readings, and instructional media where appropriate may also positively impact the student experience. Other suggestions may be less easy to accommodate. The writing assignments, for instance, are a necessary aspect of the course, and a common core requirement of a grade 9 English course, and so it is unlikely these could be reduced or eliminated. Adjusting settings in the software may be technically possible, but might introduce unwanted behaviors. For instance, adjusting the quiz settings to allow students to re-try the test immediately after it has been failed is easily done. However, this might result in students trying to guess the quiz answers rather than review the course content review before trying again. Working from home, while technically possible, also introduces the potential for friends or family members to complete the course work for students. The need for the graded aspects of the course to take place in class, therefore, is necessary for course and program integrity.

### **Instructor Experience**

As can be seen from some of the instructor's comments already noted, the interview shed light on several aspects of the student experience. The interview also provided insights into the characteristics of the participants, impressions of the UDL course features and the challenges introduced by the inclusion of the mastery assignments.

According to the instructor, the "make-up of the student was similar in both classes", However, the instructor did note a difference in student characteristics between credit recovery and original credit students. Based on their lack of previous success, many of the credit recovery

students have a “lack of confidence, so they're not particularly willing to trust themselves or put themselves out on a limb.” Self-efficacy has been shown to explain variation in achievement in both academic performance and academic persistence (Multon, Brown, & Lent, 1991). In their predictive model of the likelihood of participant success in Virtual High School online credit recovery courses, Roblyer and Marshall (2002) also identified self confidence/self-esteem as a key factor in student success. In addition to a lack of self-confidence, the participants in this study may also:

have a lot of distractions, and they're not particularly consistent as far as their attendance. They sometimes have jobs and other responsibilities and there are other distractions, maybe within their families.

Given the challenges that these students have experienced previously, and their notable lack of the key success characteristics identified by Roblyer and Marshall (2002), the need for high-quality local and distance instructional support again appears to be paramount for this group. The instructor was also clear on the importance of the local support. As she phrased it:

The ones that have a tendency to be less successful are the ones that have very limited support or no support at their local site. I know the ones that do better have someone in the school or at home that is regularly checking in on them and making sure they're making progress.

As the curriculum director of the virtual school also noted in regard to earlier research on the virtual school “In the end, a smart, caring, talented and insistent adult is going to make the student successful,” (Neiffer, as cited in Martines, 2016, para. 7).

For the credit recovery population in general, the instructor thought that a mastery-based approach was particularly beneficial. The mastery-based format:

actually pushes them to learn something in ways that other models I've seen both in schools and online don't. I appreciate the fact that they have to show some understanding of the concepts before they can move on.

Mastery based approaches are generally associated with competency-based programs, which usually have the following characteristics:

- Students advance upon demonstrated mastery
- Competencies include explicit, measurable, transferable learning objectives that empower students
- Students receive timely, differentiated support based on their individual learning needs
- Assessment is meaningful and a positive learning experience for students
- Learning outcomes emphasize competencies that include application and creation of knowledge, along with the development of important skills and dispositions

(Lopez, Patrick, & Sturgis, 2017, p. 58-59)

While a number of these elements are present in the course, the assessment process more closely resembles a traditional model where feedback is given on the work completed rather than being embedded in a technology-supported competency-framework. However, the stated items above adequately relate to the mastery-based approach used in the virtual school.

An area of increased attention for competency-based programs is the use of adaptive learning that can help to personalize feedback more effectively for students. Contemporary

approaches to adaptive learning leverage the learning technologies to automate feedback on tasks on an ongoing basis. They serve as personalized learning guides that allow students to move through the content with embedded supports and relevant feedback during the completion of the work. At the post-secondary level, an example of an adaptive learning approach for English is the EdReady English platform. EdReady English requires students to select a goal, and then take an assessment to find out what they know, results are presented as an EdReady score showing what students need to study and what they can skip. The score is shown on a sliding scale that compares it to a goal-based target score. EdReady English then builds a study path between the current score and the target score with educational resources for each of the study path elements. Students choose which learning resources they would like to use. When students think they know a concept, they can check their knowledge and progress along their study path as they achieve mastery.

While the current program uses aspects of a competency and mastery-based approach, the need for personalization noted by two of the students could perhaps be more effectively met through the application of a more adaptive learning technology such as EdReady English for a credit recovery population. As the course requires a written component, there would remain a need for a qualified instructor to be associated with the course, and the importance of local support will still be key. However, the ability to personalize the content and feedback in this way might help students who need the additional support achieve mastery more effectively. No doubt the current content of the EdReady English program would also need to be adapted to an English 1A audience as well.

The UDL course features were generally seen as favorable by the course instructor. The

instructor's positivity appeared to be aligned with her own personal feelings toward having multiple ways of promoting student engagement as noted in the earlier quotation on her looking for those features in her courses all the time. The instructor did not have access to the administrative aspects of ReadSpeaker and TextAid, so she could not see how students were using these tools. However, she remained positive on their inclusion. Benefits were noted in the inclusion of the additional directions and instruction provided in the quiz formats. The instructor thought that responses suffered from less challenges due to the additional guidance offered in the quiz instructions: "I wouldn't see [incomplete sentences] on the quiz version because they weren't making the same sort of mistakes." The instructor thought the sentence starters were particularly useful, and an element that she would use more in her teaching in the future. "If you have a sentence starter there, it sets them up a little bit better for success". Similarly, the instructor thought that having closed captions was positive for students.

In the final section of the interview, the instructor also made a general reference to the benefits of incorporating a UDL approach. She noted that it allows "students to access information and demonstrate their knowledge in ways that are specific to their strengths." When asked to clarify which particular benefits she was thinking of, she noted the importance of captions and audio transcripts in particular. The instructor re-iterated that the mastery-based approach was particularly beneficial to the credit recovery population.

In terms of the instructor's administrative engagement with the course, the most notable change was in the delivery and approach to feedback due to the inclusion of an alternative mastery assignment. Having to grade assignments through a different tool in Moodle (quiz as opposed to assignment) was identified as the biggest source of frustration. The quiz tool required

the instructor to provide feedback at the individual question level, which increased the grading time. It also required an adjustment to how the instructor was grading the assignments as the original rubric could not be applied to individual questions. For example, the grade for the mechanics of the writing had to be reconsidered for each question as opposed to the assignment in total. The instructor also wondered whether it was more challenging for students to get the feedback and review it. After grading in this way for the two semesters, the instructor began to value to the approach. "I think there's probably a benefit to me to be grading those individual elements because it really forces me to break down what it is I'm looking for when I'm looking at it holistically." However, if an instructor was less amenable to adapting her/his grading practices, the adoption of the choices may have been problematic. It is, therefore, worthwhile considering the impact of UDL-based course features on the instructional practices when implementing new features. Research has found that teachers appreciate technology when it fits with their educational beliefs (Lim & Chan, 2007; Tondeur, Kershaw, Vanderlinde, & van Braak, 2013). When it does not fit with their beliefs and causes complications in their practices, we may expect frustration and concern to turn into a desire change the system back to the way it was.

### **Limitations of the Research**

This research had several limitations. First, while the sample size was suitable for the experimental study (n=133), a number of enrollments (n=24) could not be included as their principal did not give consent for student participation in the study. This meant that the sample may not fully representative the credit recovery population in this context. The research was also limited to a single state virtual school over two semesters. The context-specific demographics of the groups suggest that caution should be used when generalizing the findings to other

educational contexts. It is likely that other school districts in different regions and states have different demographics and environmental factors that impact achievement and the perception of the learning experience in different ways.

I was originally optimistic that the randomization by the Student Information System of students into the control and treatment groups would be fully automated. However, because of the sign-up requirements for the credit recovery program, local support staff had to enroll students in the course sections. The process became one where the SIS would present both course sections as options and the staff selected one section or another. If a section filled, the SIS would only show the link to the non-full section. If a student dropped from a section, the link would then be made available for additional enrollments. This resulted in slightly uneven group composition numbers across semesters (control,  $n=68$ , treatment,  $n=65$ ). As enrollments were made by local staff across the state at various times over a period of months, enrollment was randomized by their selections and the diverse populations that were enrolling. However, the randomization process was not under full control of the researcher, or randomized directly by the SIS. In addition, GPA scores for students were only reported for approximately 50% of the students, which means that it is possible that higher achieving students could have been in one course section more than another. The similarity in pre-test scores across groups, however, seems to counter this potential threat.

Reproduction of the study may also be limited by the specific technologies in use by the virtual school. While many of the adjustments are possible with other Student Information and Learning Managements Systems, certain technologies supported this particular implementation in ways that may not be reproducible in other settings. For example, the use of the Personalized

Learning Designer to trigger drop surveys to be sent is a proprietary technology developed by Moodlerooms (Blackboard Inc.) for their version of Moodle. However, the inclusion of the eText support technologies ReadSpeaker and TextAid could easily be made by other virtual schools using Moodle, or other commercially available Learning Management Systems.

Student experience information was limited to the in-course evaluation after the end of Module 1. While this was helpful in learning more about student experience, it was difficult to fully account for the student experience without the follow-up interviews. There were challenges with both identifying the users of the eText support tools as ReadSpeaker does not track individual use, and in getting a response from participants who were contacted. The administrative tools are far superior in TextAid and provided participant identifiers that helped select participants for follow-up interviews. More effective implementation of TextAid in the Fall 2016 Semester would have allowed for more users to be identified, and more potential follow-up interviews. A research approach that involves direct collaboration with school principals is likely needed to ensure student participation in the future. Alternatively, a facilitated approach that includes the virtual school connecting the researcher with the principals may be helpful. In both cases, arranging an in-person appointment with the principals is likely to be key. A good number of principals were not quite sure what the study involved from the e-mail explanation, and having a conversation over the phone generally proved helpful in getting approval to access the student data.

### **Implications for Further Research**

While the UDL framework is underpinned by substantial literature in the field of neuroscience, psychology and education, the results from the actual studies that explore the



impact of UDL show great variation (Capp, 2017; Ok, Rao, Bryant, & McDougall, 2017). This study does not provide any evidence to support a positive effect on achievement of the inclusion of specific UDL course features. However, it points to the potential benefits of a more extensive program redesign based on UDL principles that includes the local support staff as well as the online learning environment. Following McGuire (2014) and Capp (2017), further empirical and experimental research is needed on the impact of UDL interventions on educational outcomes in order to continue to address the effectiveness of UDL based design approaches on learning.

The research also demonstrated an evaluation methodology that could be applied in other credit recovery situations to investigate student achievement. One of the outcomes of the study was a research contract being developed between the virtual school and the Office of Public instruction for data sharing. This can provide the basis for further data collection and evaluation on behalf of the virtual school as they continue to address interest from the state on the effectiveness of the credit recovery program. While the demographic of race has been shown to have mixed impacts on achievement previous studies (Nourse 2016; Lewis, 2016; Stallings et al., 2016), it is something that should be included in future data sets from the OPI. Given that 6.6% percent of the state is composed of individuals who identify as American Indian or Alaska Native alone (U.S. Department of Commerce, 2016) and the likelihood of these students taking online courses, it would be helpful to also investigate whether the course experience meets the needs of culturally diverse learners. Capp (2017) also observed that as an inclusive “teaching methodology, the effectiveness of this approach needs to be examined for gifted and talented students, indigenous students, ESL students, and so on” (p. 804).

Given the rapid growth in online credit recovery opportunities, and the limited research support to date, there is clearly a need for continued research into online credit recovery courses to improve the effectiveness for students (Barbour, 2017; Powell, Roberts, & Patrick, 2015). In regard to educational research into online credit recovery more generally, the question has been framed as “how to optimize instructional designs and technology in the online context in order to maximize learning opportunities and student achievement.” (Pettyjohn & LaFrance, 2014, p. 209). Given the results of this study, it seems clear there is a need to expand that scope to include the programmatic supports for learners. As the UDL framework can also be used at the macro level, program evaluation could be explored through an application of the guidelines and checkpoints to programmatic considerations.

The challenges highlighted with determining how existing UDL course features impact the inclusion of other course features also suggests the need for further refinement of the Universal Design for Learning framework. It may be that the practices need further validation for their situation within the framework. What makes the use of charts, calendars and schedules, for instance, relate to the ‘minimize threats and distractions’ checkpoint (7.3), and not the ‘use multiple media for communication’ checkpoint (5.1)? Moreover, what makes the use of charts, calendars and schedules UDL course features at all? The actual determination most likely rests in an understanding of the complex interaction of personal and environmental factors in play when individuals engage with particular course features. Providing a means to further validate the UDL framework through lines of situated research that addresses individual differences may further aid in understanding the role of certain impacts within the framework. Lines of inquiry might include those followed in individual difference research such as the role of “knowledge, skills, and abilities in the cognitive and psychomotor/physical domains; personality, including ...

integrity testing and emotional intelligence (EI), as well as motivational traits (Sackett, Lievens, Van Iddekinge, & Kuncel, 2017). From the online credit recovery and virtual school literature, motivation and self-efficacy seem to be worth particular attention (Archambault et al., 2010; Hartley & Bendixen, 2001; Oliver, Osborne, Patel, & Kleiman, 2009; Robinson-Carlton, 2016).

To return to the example of charts, calendars and schedules, there is likely nothing intrinsic that makes them UDL course features as they have been in use by teachers for decades to help learners, but there may be specific contexts and certain learners that benefit most from the inclusion of these items. As the UDL framework seeks to differentiate itself by being a scientifically valid framework based in emerging understandings of brain functioning, this differentiation also needs to emanate from knowledge of the impact of UDL approaches on individuals in specific learning contexts. In other words, making the use of charts, calendars and schedules UDL-based approaches, and not just good teaching, ultimately lies in determining the evidence-base to support the inclusion of specific features in specific contexts to maximize the learning potential of individuals.

### **Implications for Practice**

There is some evidence to suggest that the inclusion of choices with sentence starters and the eText support tools were beneficial for certain individuals even if the impact was not determined to be statistically significant or important. For an educator, an incremental approach to adding UDL based courses features may be warranted by the individual benefits alone. However, as the impact was more limited than hypothesized, a UDL redesign that reviews various aspects of program structure, including local support, would likely prove more impactful for learners.

In terms of the integration of different technologies to support diverse learning needs, a good starting place is always the functionality of the LMS. LMS' provide a host of tools that can be used for teaching and learning that often go under-utilized. The support of educational technology companies can also be leveraged in the support of learning. Throughout this study, which lasted over a period of 2 years, ReadSpeaker Inc. proved to be a great research partner. This included support from their educational research, sales, and technical support teams. The willingness of companies to investigate applications of their technology for teaching and learning obviously helps develop a potentially good client-vendor relationship, but the benefits may be mutual, and are often worth the time for both parties.

Simple pedagogical adjustments can be helpful to the learning experience as well. Perhaps one of the most powerful tools in understanding student experience came from the inclusion of the in-course survey. Given the range and quality of insight gathered from the required survey after Module 1, this should be included in future online credit recovery courses to gather ongoing feedback on the course experience. It should also be noted that the inclusion of an in-course survey fits within the UDL framework as a means to continue to optimize relevance, value and authenticity (checkpoint 7.2). We cannot assume that all activities are going to be as equally engaging for all users and so must continue evaluate their relevance and make them as rewarding as possible.

The scan tool used in this review was designed for the evaluation of software based on UDL principles. In the process of reviewing the course, the evaluation shed light on course pedagogy as well. It would not be a stretch to adapt the scan tool to address instruction, support services, information technology and the learning environment (Burgstahler, 2013). This adapted

version of the scan tool could be used for the initial review of overall program and provide insights into which practices may need to be adjusted or improved.

## **Conclusion**

This study investigated the impact of UDL course features on student achievement in an English 1A online credit recovery course. The results of the study did not indicate any statistically significant or important impact on achievement. The higher passing rate in the treatment section (9% for enrollments, 5% for individuals) was notable across groups. However, caution should be exercised in attributing the better passing rate to placement in the UDL treatment group. Given the identified importance of the instructor and the local support, the major conclusion of this study is that it would be worthwhile addressing achievement through exploring instruction, support services, information technology as well as the learning environment (Burgstahler, 2013). Educating local support staff through UDL-based training on the technologies and environmental factors that help learners succeed may be one way to increase passing rates. Furthermore, it would be worth investigating the interactions of individual characteristics and learning preferences as students engage in specific learning contexts. In this way, educators and schools can develop the evidence-base to support contextualized UDL-interventions. One of the challenges of our time is to improve the education-levels and graduation rates of students entering contemporary society. This may serve to positively impact individual opportunity and well-being in contemporary life as well as the nation's social fabric and global competitiveness. Changes made to critical learning environments, such as the English 1A credit recovery course, are an integral part of graduation success for diverse learners, and merit further attention as we strive to support a more inclusive society for all individuals.

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## Appendices

### Appendix A: Survey Tools

#### In-course Survey

How are things going in the course? Please provide us some brief feedback on your experience so far.

Use the boxes below to let us know about what you think of the course. Use the slider to indicate a percentage value from 0% (lowest) to 100% (highest).

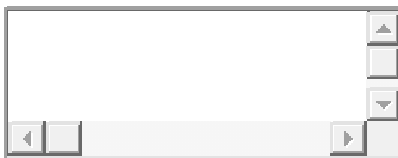
I feel I am learning a lot in this course.

I find the course challenging.

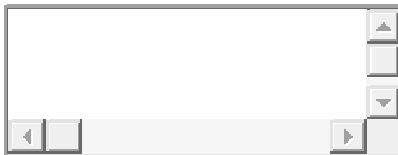
I find the course easy to navigate.

I am satisfied with the learning experience.

What features of the course do you like or find helpful?



What do you think would make the course better?



#### Drop Survey

Thank you for taking the English 1A Credit Recovery course offered by the Montana Digital Academy. You are receiving the message because you have dropped the course. We would greatly appreciate it if you would take a few moments to let us know your reasons for dropping the course. The information is anonymous and will be used to improve the experience for other students. There are 4 questions.

Why did you decide to take the course?

Why did you not complete the course?

Is there anything that would improve the experience for you?

Please let us know if you have any further comments, questions or concerns.

## Appendix B: Coding Frameworks

### Survey Responses

Most frequent response (rank: 1,2,3)	Q.3. What features of the course do you like or find helpful?	Reviewer category (i.e videos)	Count (#)
	The videos were helpful		
	All the videos that they provide and choices between what i want to do with the mastery assignment.		
	The main thing I like about this course was the I-Search paper. This project was fun and easy to do so it made it non challenging for me so I could focus on the topic and get it done faster then a regular high school project would challenge me		
	everything		
	the doop detector		
	I like the fact that you can choose to take a quiz, or do an assignment. I also like the ability to access a tutor if I need to.		

### Interview

Instructor Interview – English 1A Credit Recovery (July 18, 2017)			
Preliminary Codes	Interview Transcript and Code	Possible Categories	Notes, Quotes, Ideas, Patterns, Themes
<b>Students are similar</b>	(Instructor) I didn't notice a significant difference. I think <b>the make up of the student was similar in both classes</b> . Oftentimes I didn't know which course they were in until I went to grade the assignment. Then I could tell the difference. That's helpful. Obviously I'll get background information and I'll be able to see a little more about the composition, but it's helpful to get your impression as well just to confirm.	Student characteristics	Instructor didn't know which course the students were in, so the students seemed similar

## Appendix C: Consent Protocols

### Parental/Student Consent Letter

Dear Parent/Guardian of \_\_\_\_\_,

With permission of schoolname, UM and the OPI, I am currently conducting a study on students' experiences in the English 1A course offered by the Montana Digital Academy in Spring and Fall 2017. Your daughter/son participated in the course, and I am interested in interviewing her/him on their course experiences. The interview would be conducted via Skype or another web-conferencing tool on school premises at a time that works for the school and your daughter/son. It will take about 30 minutes. I am writing to seek both your consent and your daughter/son's consent to participate in the interview. I have included both a parental and student consent form that provides more information on the study, and the safeguards in place. If you and your daughter/son, could sign the appropriate form and return it me, I will arrange the interview. You daughter/son will receive a \$25 gift card to Amazon for participating.

I greatly appreciate your consideration. The study has the potential to improve our understanding of the English 1A course online, and further our ability to design effective learning experiences online.

Thank you, and please feel free to reach out to me if you have any further questions.

Robert

Robert Squires

Director of Instructional Design and Technical Support  
The University of Montana, Missoula 59812  
Office: 406.243.6056  
Mobile: 406.240.3837

### Minor's Assent for Being in a Research Study University of Montana

Title: Does adding new course features make a difference to how well students do in an online course?

#### Why me?

We are asking you to take part in a research study because we are trying to learn more about how adding certain course features make a difference to how well students learn in an online course We are inviting you to be in the study because you participated in the English 1A online course that was offered by the Montana Digital Academy in Fall 2016 and/or Spring 2017.

#### Why are you doing this study?

We are doing this study so we can find out if certain course features improve learning. We would like to build the best possible online courses for students, and this study will help us identify some ways to do this.

What will happen to me?

You will meet with the researcher at your school or online via Skype or FaceTime. You will look at the English 1A online course again, and you will answer a series of questions about your experience in the course.

Will the study hurt?

There will be no physical contact during the study. The questions that will be asked will address the curriculum.

Will the study help me?

The study will not help you directly, but it may be helpful for other students who will take Montana Digital Academy courses in the future. You will receive a \$25 gift card to Amazon for participation.

What if I have any questions?

You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me Robert Squires, (406) 243-6056.

Do my parents [guardians] know about this?

This study was explained to your parents [guardians] and they said that you could be in it. You can talk this over with them before you decide.

Do I have to be in the study?

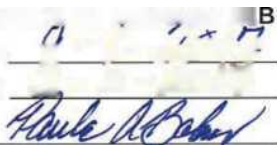
You do not have to be in the study. No one will be upset if you don't want to do this. If you don't want to be in this study at any time, you just have to tell me. You can say yes now and change your mind later. It's up to you.

Writing your name on this page means that that you agree to be in the study, and know what will happen to you. If you decide to quit the study all you have to do is tell me or the person in charge.

Name of Minor (printed)

Signature of Minor      Date

Signature of Researcher Date

**The University of Montana IRB**


Paula A. Baker

**Parent's Assent for Being in a Research Study University of Montana**

**Research Title:** The Impact of Universal Design for Learning Course Features on Achievement in an Online Credit Recovery Course

**Investigator(s):**

Robert Squires, Todd Building 316, School of Extended and Lifelong Learning, Missoula, MT 59812 (406) 243-6056. Faculty supervisor: Morgen Alwell, Associate Professor, College of Education and Human Sciences, Missoula, Mt 59812, (406) 243-5512

**Special instructions:**

This permission form may contain words that are new to you. If you read any words that are not clear to you, please ask the person who gave you this form to explain them to you or contact the project director.

**Purpose:**

You are being asked to give permission for your child to take part in a research study comparing student achievement and satisfaction in the English 1A online credit recovery course offered by the Montana Digital Academy. You have been asked to participate because your child took the English 1A course in Fall 2016 and/or Spring 2017. The purpose of this research study is to learn how certain changes made to the English 1A course curriculum made a difference to your child's success in the course. The results will be used for improving the learning experience for future students and provide insights into designing effective online learning for high school students.

**Procedures:**

If you agree, your child will be asked to meet at your local school or via a web-conferencing tool such as Skype or FaceTime. A member of high-school staff will also be present.

Your child will look at the online course with the researcher and be asked a series of questions on the experience in the English 1A course. The session will last for about 30 minutes.

**Payment for Participation:**

Your child will receive a \$25 Amazon gift card for participation.

**Risks/Discomforts:**

There is no anticipated discomfort for those contributing to this study, so risk to your child is minimal.

**Benefits:**

Although you may not directly benefit from taking part in this study, the study might help improve the online course experience for other students taking courses at the Montana Digital Academy.

**Confidentiality:**

All records will be kept confidential and will not be released without your consent except as required by law.

Only the researcher and his faculty supervisor will have access to the files.

Both your and your child's identity will be kept private.

If the results of this study are written in a scientific journal or presented at a scientific meeting, neither your nor your child's name will be used.

The data will be stored in a locked file cabinet.



Your child's signed assent form, as well as this parental permission form, will be stored in a locked cabinet separate from the data.

The audio recording will be transcribed without any information that could identify your child. The tape will then be erased.

**Voluntary Participation/Withdrawal:**

Your decision to allow your child to take part in this research study is entirely voluntary.

You may refuse to allow your child to take part in or you may withdraw your child from the study at any time without penalty or loss of benefits to which you or your child are normally entitled.

Your child may leave the study for any reason.

**Questions:**

If you have any questions about the research now or during the study contact: Robert Squires (406) 243-6056

If you have any questions regarding your child's rights as a research subject, you may contact the UM Institutional Review Board (IRB) at (406) 243-6672.

**Parent's Statement of Permission:**

I have read the above description of this research study. I have been informed of the risks and benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions I may have will also be answered by a member of the research team. I voluntarily agree to have my child take part in this study. I understand that I will receive a copy of this permission form.

Printed Name of Participant (Minor)

Signature of Parent or Legally Authorized Representative

Printed Name of Parent Date

9-1-2017<sup>B</sup>  
-2017  
Robert L. Baker

**The University of Montana IRB**

## Appendix D: Interview Protocol

### Course instructor

Subject Code: \_\_\_\_\_

Date: \_\_\_\_\_

Gender: \_\_\_\_\_

Time: \_\_\_\_\_ (am / pm)

Interviewer: \_\_\_\_\_

Setting: Webconference

### Opening Statements:

Thank you for agreeing to take time from your busy schedule to participate in this research study. There are a few things that I would like to make sure you understand before we get started.

- I will be asking you some general questions and recording as we proceed.
- All information from this interview will be confidential. That is, you will not be identified by name, location, or place of employment in this study or in any report from this study.
- You will be identified by a fictitious name in these notes. A confidential subject code will be used to identify you for any follow up questions.
- No direct quotes from you will be used in the study without your prior permission. When quoted your identity, location, and place of employment, will remain confidential.
- Your name and place of employment will only be known by this researcher and Dr. Alwell, Department of Teaching and Learning Associate Professor, The University of Montana.
- You may stop this interview ant anytime without any negative consequences.
- You will hear the term universal design for learning throughout the interview. This term means inclusion of course features that support the needs of diverse learners.

Please be assured that there are no correct answers to the questions that I will be asking. What is important, are your thoughts, feelings, and experiences. The intent of this interview is to gather your thoughts, feelings, and experiences, not to make judgments on your responses.

**Interview Questions (instructor)****Student population**

IQ1: What was your sense of the composition of the two groups? Did they appear to be similar in both Fall and Spring?

IQ2: What particular challenges have you experienced in teaching these courses? How does this relate to the student population you typically have in these courses?

IQ3: How would characterize the students that typically take these courses?

IQ4: From your experience, what aspects of the course have you found most helpful to students? What have they found most challenging?

**Universal Design Course Features**

IQ5: What did you think about the effectiveness of including the following course features for students?

1. ReadSpeaker
2. TextAid
3. Optional assignments
4. Captions
5. Sentence starters

IQ6: Do you have any other comments about the effectiveness of these course features for students?

**Course administration**

IQ7: The adjustments to the course resulted in a different way for you to grade assignments. What was your experience of that?

IQ8: What, if any, issue(s) did you experience with the course format based on the changes?

IQ9: Did you receive any feedback from students that made you question the changes made to the course? If so, what was it?

IQ10: From a teacher's point of view, what other thoughts do you have on the adjustments to the course?