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Effects of Universal Design For Learning on Faculty and Student Outcomes in Postsecondary Online Courses

Michael P. Matis Ph.D

EFFECTS OF UNIVERSAL DESIGN FOR LEARNING ON FACULTY AND

STUDENT OUTCOMES IN POSTSECONDARY ONLINE COURSES

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Abstract

As diversity of student enrollment increases, postsecondary institutions must address the inclusiveness of physical and virtual learning environments. Doing so requires engaging faculty in a conversation about their online pedagogy and course design. This study employs Universal Design for Learning (UDL) as a means for faculty to reflect on and solve instructional problems in their courses. It follows a sequential, exploratory, quasi-experimental, mixed-methods approach. Instructor-focused, in-depth interviews capture the experience of instructors as they reflect on their personal history that led them to teaching. They identified a portion of one of their online courses to improve and selected modifications inspired by the UDL framework. They also reflect on the subsequent interactions with their students with a focus on changes they have observed in relation to the modified portion of their course. The student-focused portion of the study examines the effect these modifications have on student outcomes through quantitative and qualitative analysis of their responses to a survey. The student-provided data were compared across control and treatment sections for each course. This study demonstrates how the UDL framework and guidelines can be used as a tool for qualitative research in addition to its traditional role as a prescriptive model. The synthesis of all data from the study provides postsecondary educators with an empirical account of UDL's utility and attempts to address barriers to adoption.

Dedication

To all of my loved ones who supported me through patience and encouragement, while simultaneously enduring my absence.

Author's Note

- Supplemental resources for this dissertation research may be found on my website, https://mmatis.net/udl.

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Chapter 1: Introduction

Statement of the Problem

Universal Design for Learning (UDL) proposes guidelines based on peer-reviewed cognitive neuroscience for creating learning environments in which students can receive information, express their knowledge, and become engaged with their learning in ways that meet their diverse abilities, needs, backgrounds, and preferences (Center for Applied Special Technology, 2011). UDL's summative goal is to enable students, regardless of background, to become expert learners: "individuals who want to learn, who know how to learn strategically, and who, in their own highly individual and flexible ways, are well prepared for a lifetime of learning" (CAST, 2011, p. 4). While UDL's original authors, Meyer and Rose (2014) admit their framework must be validated by research, one of the many models UDL draws from and incorporates is the concept of expert learning. Expert learning is not a UDL construct, but one with a long research history that emerged from the study of expertise in the field of cognitive psychology (Chi et al., 1988 as cited in Ertmer & Newby, 1996) and can be thought of either as synonymous with, or a product of well-developed metacognitive skills.

UDL becomes relevant when considering over the last several decades, postsecondary education has seen a continuous increase in the diversity of its students (Espinosa et al., 2019; U.S. Department of Education, National Center for Education Statistics, 2010, 2012, 2019). In this context, diversity is the

presence of difference in a given setting (Tan, 2019). This may include people of color; people with varying levels of physical, cognitive and English language ability; adult learners; first-generation college students; people without reliable access to the internet; and people without reliable housing or access to a space conducive to study. CAST frequently uses the term "learner variability" to encompass these factors which affect students' academic persistence and performance. This factor of increasing diversity or learner variability collides with the pedagogy students encounter in their academic work which often follows the "factory model" of education which assumes students are equal, empty vessels to be filled with knowledge by otherwise well-meaning instructors (Delaney, 2000; Phuong et al., 2017). This is combined with a reliance upon assessment practices, whose historical origins placed more value on western, white, and male ideals of objectivity and individualism, while minimizing other forms of expression, such as subjectivity and collaboration, (Filer, 2000; Hanesworth, 2019; Leathwood, 2005; Madaus, 1994). This worldview potentially creates learning environments that are increasingly exclusionary as student diversity increases.

UDL provides a different way of thinking about teaching that takes the diversity of learners into account (Rose & Meyer, 2002). Thoughtful integration into the teaching practice of faculty may help postsecondary education better serve a more diverse student population and create a better learning experience for all students. However, UDL itself has some inherent barriers that prevent

educators from trusting, understanding, and therefore integrating UDL into their

teaching and course design. These barriers include a lack of empirical research

into its effect on student outcomes (Basham et al., 2010; Davies et al., 2013; Izzo

et al., 2008; Kennedy et al., 2014; Ok et al., 2017; Seok et al., 2018; Spooner,

2007; Westine et al., 2019). Additionally, UDL's complexity and assumption of

fluency in pedagogical concepts may be overwhelming to faculty who are not

already specialized in the field of education research (Kennedy, et al., 2014; Tobin

& Behling, 2018). Finally, the lack of a clear implementation process for improving

existing or building new learning experiences presents additional barriers for

faculty attempting to apply UDL (Kennedy, et al., 2014; Westine et al., 2019).

Purpose of the Study

Diversity of all forms has increased among enrolled college students in the

late twentieth and early twenty-first centuries. The last several decades have seen

an expansion in the racial and ethnic diversity of college students (Espinosa et al.,

2019; NCES, 2010); a trend which is expected to continue into the 2030's

alongside a sharp decline in high school graduates (Bransberger, 2017). English

language learners are also more common due to increased immigration and higher

international student enrollment (Bergey et al., 2018). The number of students

with reported disabilities has increased as well. According to the U.S. Department

of Education's National Center for Education Statistics (NCES), 11% of

undergraduate students had reported a disability with their institutional disability

services office during the 2011-2012 academic year (NCES, 2012). In 2015-2016, this amount climbed to 19% (NCES, 2019).

Table 1.1

Summary of statistics on students with disabilities in the United States.

Undergraduate students reporting a disability	
2011 - 2012[1]	11% of students reported disabilities to their institution
2015 - 2016[2]	19% of students reported disabilities to their institution (8% increase)
Non-Reporting students with disabilities (n = 2366)[3]	
A	9.3% (n = 221) reported having a documented disability.
B	Of the amount in 'A', 69.7% (n = 53) did not disclose their disability to their institution.
C	Of the amount in 'A', 45.8% (n = 65) indicated that their disability impacts their ability to succeed in online courses

[1] *National Center for Education Statistics, 2012*
[2] *National Center for Education Statistics, 2019*
[3] *Roberts, Crittenden, & Crittenden, 2011*

However, because not all students with disabilities report them to their institution, this amount is certainly much higher (Fichten, et al., 2009; Grimes et al., 2019). In a multi-institutional survey of over 2,366 postsecondary students, 9.3% reported having a documented disability. Of those students, 69.7% of the original 9.3% did not disclose their disability to their institution, however 45.8% of the original 9.3% indicated that their disability impacts their ability to succeed in online courses (Roberts et al., 2011). If this study represents a trend for all U.S.

postsecondary institutions, that would mean for every student that reports their disability to their institution's DSC, there are two or three that do not. Social stigma felt by students with "hidden" disabilities may explain this phenomenon (Kimball, 2016). These are students with disabilities that affect their cognitive ability or psychological state. They fear being singled out, becoming outsiders among their peers, or being treated differently by their instructors.

Independent of these demographics are situational factors which add further nuance to modern postsecondary students. Many are not prepared for college and will need remediation (Adams, 2015); or are adult learners balancing career, education, children, and other priorities (NCES, 2017). As of the 2015-2016 academic year, 56% of undergraduate students were first-generation college students (RTI International, 2019). Finally, while not typically included in discussions of student demographics, access to the internet also affects student success in courses. Not all students have the same access to the internet and/or access it through the same device. For example, according to Pew Research, 17% of adults access the internet exclusively through a smartphone (Anderson, 2019). Access to the internet is also affected by socioeconomic and ethnic status (Yoon et al., 2020).

All of these dimensions, including socioeconomic status and first-generation college student status, availability of internet and device access, and available study environment contribute to how students perform in their

academic work. Increased diversity means that each student is a unique individual with various situational factors, histories, and experiences that will affect how they react under various learning conditions. There is no single set of teaching methods that will be effective for all students in every case. Coming to grips with the variability of our students in the classroom and online learning environments is crucial to the success of our students and, thus, the retention and graduation rates of postsecondary institutions.

Universal Design for Learning represents a synthesis of modern teaching concepts and methods that have entered the practice of education over the last fifty years (Rose & Meyer, 2002). It is designed to address the challenge of learner variability. Institutional adoption and acculturation of UDL at the postsecondary level could enable institutions to meet the demands of the 21st century. In terms of online courses, the proactive application of UDL has the potential to eliminate the need to modify courses for most disability accommodations after-the-fact (Casper & Leuchovius, 2005; Tobin & Behling, 2018). This built-in flexibility is of immediate benefit to all students regardless of their individual characteristics and allows them to engage with the course in ways which allow them to leverage their strengths (Westine et al., 2014). However, there are barriers to the increased adoption of UDL at the postsecondary level which this study attempts to address. These barriers are described in more detail in the *Significance of the Study* section later in this chapter.

Research Questions

1. *How does guided engagement of UDL change instructors' perception of their students, courses, and practice as an educator?*

2. *How does the addition of UDL-driven course modifications affect students' perceptions, work, behavior, and whether their learning needs are met within an online course?*

The action research and phenomenological interview stages of the study provided the data for addressing the first, instructor-focused research question. Data from the second, student-focused research question were used to guide the summative third interview and analysis portion of the instructor-focused portion of the methodology. The parent institution's faculty were surveyed to collect a pool of interested participants. Two faculty from this pool were selected. A three-interview series proposed by Seidman (2006) was employed to gather data on the participating instructors' experience. An initial interview was conducted to elaborate on their responses to the survey, gather their personal history with online teaching and learning, and to discuss UDL. The end result of the initial interview was the instructor-driven selection of one aspect of their course to improve using UDL-aligned modifications. To prevent an increase in participants' workload, I implemented their mutually agreed upon modifications with their direction, feedback and approval. A written "modification proposal" was generated and formed the centerpiece of discussion during the second interview.

The second interview took place upon completion of the modification proposal. It consisted of a review of what was discussed in the previous interview and an opportunity to further refine the modifications to their course. The interview also allowed me to ask follow-up questions delving deeper into themes from the first interview and transition our conversation to their current teaching practice as well as address the responses they made to the open response questions on the participant selection survey.

The third and final interview examined the instructor's experience with their course post-modification and their reactions to data collected thus-far from the student-focused phases of the study. Prior to this interview, participating faculty were provided with transcripts of preceding interviews to ensure they accurately reflected their viewpoints. Next, the third interview focused on any changes in the instructors' teaching experience that may have been impacted by the course modifications, as well as differences they perceived between the control and treatment sections of their course, including the quality of their interactions with students, students' interactions with each other, and changes in their own teaching behaviors. The final component of this interview examined the social validity of the work they engaged in over the course of the study from their perspective. In other words, did the instructor feel that the process of using UDL to modify their course improved student outcomes, such as grade performance, participation, quality of work, and the instructor's own experience teaching

online.

Data to answer research question 2 came from two places. The primary is a survey focused on the modified portion of the course that contained fixed and open response questions aligned to the UDL guidelines that specifically address the part of the course chosen to modify, as well as several questions designed to address the social validity of the modifications from the student perspective. This included the students' sense of progression or accomplishment toward the course's objectives. The secondary data source was course-specific, modification-relevant data. In Course A, this took the form of various discussion assignment statistics and average discussion grades. In Course B, this secondary data was produced from an accounting of the methods students used to submit their final project and final project grades.

Significance of the Study

This study explores what happens when UDL is used as a tool to engage faculty in the assessment and improvement of the student experience in their courses. It utilizes a sequential, exploratory, mixed-methods approach with an embedded quasi-experimental component. It addresses UDL's implementation barriers by thoroughly documenting the experience of two faculty as they work with a learning designer to modify an aspect of their respective courses. It also serves as a case study to provide practitioners in administrative "Teaching & Learning" units with a model for engaging with faculty to make their courses more

inclusive. Finally, it addresses the lack of UDL-focused experimental research that examines student outcomes by performing comparisons across modified and unmodified course sections. The choice to employ control and treatment groups addresses a frequent criticism found within the literature pertaining to applications of UDL at the postsecondary level (Basham et al., 2010; Davies et al., 2013; Izzo, et al., 2008; Kennedy et al., 2014; Seok et al., 2018), but also acknowledges the inability of this study to ensure identical student composition across the experimental groups; hence the "quasi-experimental" descriptor.

Overall, there is support for the idea that UDL yields positive outcomes for students. However, this perception varies depending upon one's expectation of methodological rigor and the educational context being examined. In a literature review examining research pertaining to UDL and similar frameworks, Rao, Ok and Bryant (2014) noted that the positive results should be viewed as preliminary, due to varying methods of analysis and inconsistent definition of principles. They also observed that many of the articles in their review noted a dearth of research into the effects on student outcomes, as was also observed while preparing the literature review for this dissertation. In the context of postsecondary education, empirical research examining UDL's effects on student outcomes and/or their perceived learning processes is lacking.

If someone familiar with UDL is asked whether there is enough empirical evidence to validate UDL as "effective," their answer would depend upon which

educational context is being discussed, whether or not they accept empirical

results from educational contexts outside their own, and how positivist the

person answering this question leans. This subjectivity is apparent in the

literature. An example from the "generous" extreme of this subjectivity would be

Tobin and Behling's (2018) book on implementing UDL in Higher Education where

they assert decades of research from K-12 supporting UDL. Furthermore, much

of the published literature in the postsecondary context regarding UDL is focused

on advocacy rather than research. It treats UDL's effectiveness as a foregone

conclusion and ignores its lack of rigorous testing (Dalton et al., 2019; Dell et al.,

2015; Hollingshead & Carr-Chellman, 2019; Oswald et al., 2018; Robinson &

Wizer, 2016; Rogers-Shaw et al., 2018; Rose et al., 2006; Sapp, 2009; Tobin,

2014). At the "conservative" end of the subjectivity spectrum is Kennedy (2014)

who lists several reasons against adopting UDL, including a lack of empirical

evidence and explicitly defined terms and measurements. Several other studies

and literature reviews also share this view that UDL needs more empirical

research within the higher education context (Davies et al., 2013; Izzo et al.,

2008; Seok et al., 2018; Westine et al., 2019). For some, it is enough that UDL

itself is based on findings from cognitive neuroscience and thus those scientific

findings would intrinsically transmit to UDL itself. On the other side of this

spectrum are those, university administrators and science faculty come to mind,

who place more value upon what the empirical research says about UDL, its

effectiveness, rigor, and repeatability. Furthermore, I have anecdotally encountered a subset of that group whom will not consider research from outside their own educational context, e.g., K-12 versus postsecondary.

The goal of this dissertation research is to either strengthen the evidence-based case for UDL's adoption in the postsecondary context, or reveal weaknesses that will inform future practice and revision of the UDL framework. As a set of principles for guiding instruction, or even institutional policy, UDL's success in any setting hinges upon not only acceptance, but also internalization by those directly involved in teaching students. In order to achieve acceptance and internalization by university faculty and administrators, UDL needs to meet their expectation of quantitative and qualitative rigor as applied to the postsecondary setting.

My methodology employed action research, qualitative, semi-structured interviews of faculty, quantitative and qualitative analysis of student survey data in an embedded quasi-experimental component. The research activities centered around two instructors and their respective asynchronous online courses. Research activities covered two sections of each instructor's course, the first section acting as an unmodified control and the second course receiving UDL-aligned modifications to a particular course activity chosen by the instructor. The first instructor, David, teaches Course A which is a fourteen-week, asynchronous online, required undergraduate course in its institution's engineering bachelor's

program. The control section ran during the Spring 2021 term and the treatment

section ran during Summer 2021. The second instructor, Kelly teaches Course B,

which is a seven-week, asynchronous online, required graduate course in its

institution's Nursing master's program. Both the control and treatment sections

ran sequentially during the Summer 2021 term.

Definition of Key Terms

Table 1.2 lists definitions used in this proposal to ensure the clarity of their

meaning. Any deviations in their definition and subsequent usage from their

source literature will be clearly noted.

Table 1.2

Definition of Key Terms

Term	Definition
Asynchronous	Used in reference to an online course. It means that, other than assignment due dates, there are no time requirements imposed upon the student to be present in a specific place at a certain time.
Affective Networks	UDL's categorization of areas of the human brain which manage and regulate emotion and motivation (Kandel et al, 2012; Rose & Meyer, 2002; Meyer et al., 2014).
Accessibility	The degree to which a piece of digital media (text, images, audio, web page, etc.) is perceivable, operable, understandable, and robust to all persons (W3C, 2016).
Curriculum	Learning goals, means of assessment, teaching methods, and materials (Meyer & Rose, 2014).
Engagement	Depth of a student's behavioral, psychological, and cognitive commitment to learning. Considered a benchmark of quality instruction.
Expertise	Refers to the field of "expertise studies". Expertise is influenced through practice, exposure to good teachers, and self-direction, rather than inherent characteristics, such as genetics. Expertise is also domain specific. Experts have behaviors, strategies and knowledge they have integrated to become experts (Chi et al., 1988; Ericsson & Smith, 1991).
Expert Learning	UDL's expression of "expertise" in the context of learning. UDL is attempting to make learners experts at learning. Meyer and Rose define the following characteristics of Expert Learners: Purposeful, Motivated, Resourceful, Knowledgeable, Strategic, and Goal-Directed (Meyer & Rose, 2014).
Immediacy	The degree of closeness with others which relates to communicative behaviors to improve nonlinguistic interaction (Mehrabian, 1969). In this context, a student's sense of proximity and presence with an instructor.

Term	Definition
Information & Communication Technology (ICT)	Digital media in the form of websites, software, digital documents, video, audio, and images (U.S. Access Board, 2018).
Learning Management System (LMS)	A functional term for online software products licensed by universities to host online courses, post instructional resources, and manage student assignment submissions and grades.
Metacognition	Thinking about thinking. Awareness of one's own internal planning and evaluating process in the context of learning, and the ability to modify them (Ertmer & Newby, 1996).
Plus-One	A method for introducing instructors to UDL and engaging with instructors introduced by Tobin and Behling (2018). The instructor is asked three questions about problems they perceive in their course. The learning designer then guides them through examining those problems through the lens of UDL to address them.
Recognition Networks	UDL's categorization of areas of the human brain which manage information received through our sensory organs (Kandel et al., 2012; Rose & Meyer, 2002; Meyer et al., 2014).
Strategic	UDL's categorization of areas of the human brain which manage planning, attention, memory, and self-control (Kandel et al., 2012; Rose & Meyer, 2002; Meyer et al., 2014).
Universal Design (UD)	A set of guidelines conceived by architect Ronald Mace to allow all persons access to physical spaces regardless of ability.
Universal Design for Learning (UDL)	Anne Meyer and David Rose's framework that was inspired by UD, but is applied to learning environments, rather than physical, built environments. UDL was designed to help educators create learning environments which allow all persons to become expert learners by providing elements that acknowledge learners' individual variability (Rose & Meyer, 2002; Meyer et al., 2014).
Variability	Variability or "learner variability" is the dynamic and ever-changing mix of strengths and challenges that makes up each

Term	Definition
learner (Meyer & Rose, 2014).	

Chapter 1 Summary

Universal Design for Learning is a framework which outlines principles that enable people, regardless of cultural factors and physical or cognitive ability, to become expert learners. As access to a postsecondary education expands to more of society, this diversity translates to learners in classrooms with a variety of life factors affecting their ability to succeed. This variability inherent in learners is precisely what UDL was designed for. The acculturation of UDL within postsecondary institutions could help institutions adapt to educating an increasingly diverse population. However, UDL's validity may be in question by faculty due to the lack of empirical research regarding its effect on student outcomes, particularly within the context of asynchronous online courses. This study contributes empirical, experimentally validated research using a mixed-methods approach to the existing literature.

Chapter 2: Literature Review

This literature review consists of several sections organized with the primary purpose of profiling the current research on UDL and its effects on student outcomes in postsecondary courses, with specific attention paid to courses in the asynchronous online modality. This review also introduces the reader to Universal Design (UD), UDL, and other related and similar frameworks and concepts.

The central pool of literature consisted of 42 articles covering a variety of educational contexts. The articles were gathered through searching library databases and Google Scholar using various combinations of the terms, *UDL*, *Universal Design for Learning*, *Online Learning*, *Higher Education*, and *postsecondary*. While the intent was to focus specifically on UDL in the postsecondary sphere across all teaching modalities, a few studies from K-12 as well as a few studies pertaining to UDL's "sister" framework, Universal Design for Instruction (UDI) were inadvertently included in the initial unsorted pool of literature. Excluding these outliers, the core literature examined consisted of 31 articles. However, the outlier articles were also examined to provide context and comparative basis for the core set of UDL literature. The distinction between the parallel models of UDL and UDI is discussed later as well.

Universal Design

Before discussing Universal Design for Learning (UDL), it is necessary to introduce the original Universal Design (UD) principles which inspired it. UD is composed of the following seven principles listed below in Table 2.1.

Table 2.1

The Principles of Universal Design (Mace et al., 1997)

Principle	Definition
1. Equitable Use	The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use	The design accommodates a wide range of individual preferences and abilities.
3. Simple and Intuitive Use	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility.

Architect Ronald Mace and his team championed the development of UD at North Carolina State University's Center for Universal Design in 1997. One of

the organizations involved in the development of UD, the Institute for Human

Centered Design (IHCD), provides a history and definition of UD as conceived by

its creators: "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" (IHCD, 2020, para. 19). UD is also codified in several U.S. federal statutes

as follows:

> a concept or philosophy for designing and delivering products and
>
> services that are usable by people with the widest possible range of
>
> functional capabilities, which include products and services that are
>
> directly accessible (without requiring assistive technologies) and
>
> products and services that are interoperable with assistive
>
> technologies. (Assistive Technology Act, 1998, p. 3634-3635;
>
> Assistive Technology Act, 2004, p. 1714; Individuals with
>
> Disabilities Education Improvement Act, 2004, p. 2658)

Essentially, UD prioritizes proactive inclusion of design and development in

the physical, built world, as opposed to providing "accommodations" for people

with disabilities after-the-fact. An example of an accommodation would be adding

a ramp to a building entrance in response to people who use wheelchairs. If the

designers of the building followed the principles of UD, a ramp would be included

as part of the design and initial construction. This design element can be seen as

an overall enhancement for everyone that not only affords people using

wheelchairs unassisted access to the building, but also people with temporary leg or foot injuries, people pushing baby strollers, or people pushing a hand truck full of equipment.

While UD defines and standardizes this concept of inclusive design in the physical world, its existence in American public policy can be traced through the latter half of the twentieth century. People with disabilities were not included in the 1964 Civil Rights Act, which the legislature began to address with 1968's Architectural Barriers Act, then expanded further with Section 504 of 1973's Rehabilitation Act, the Fair Housing Act of 1988, and the American for Disabilities Act (ADA) of 1990 (Tobin & Behling, 2018). Up until this point, UD had applied to the physical world. The 1990's are when UD began to be applied to digital media, such as software, electronics, and the Internet, which ran in parallel with extensions to the aforementioned legislation.

Information and Communication Technology (ICT) is defined in the 2017 revisions to Section 508 of the Rehabilitation act (known colloquially as the "508 refresh") as digital media in the form of websites, software, digital documents, video, audio, and images. The Rehabilitation Act of 1973 and the 1990 incarnation of the ADA addressed the accessibility of physical spaces, such as wheelchair ramps for entrances. In 1998, the Rehabilitation Act was amended with Section 508 where the rules for ICT were introduced (Barker, 2017). Section 508 was amended again in 2017 in response to the rapid progress of computers

and the internet since 1998.

Universal Design for Learning

Brief History

  The 2014 book by Anne Meyer and David Rose, *Universal Design for Learning: Theory and Practice*, provides the history of UDL's origins summarized below. The Center for Applied Special Technology (CAST) was founded in 1984 by Anne Meyer and David Rose in Wakefield, Massachusetts. Its founding occurred when personal computers were just beginning to become widely available to consumers along with early Internet service. In the policy sphere, the Regan administration had recently released its landmark education report, *A Nation at Risk*, spurring nationwide school reform efforts.

  Meyer and Rose (2014) saw the potential for technology to address the needs of students "in the margins" who struggled with learning. They sought to use technology to help students overcome barriers in the classroom and "amplify areas of strength and support areas of weakness." They used the example of providing a word processor to a student with great ideas, but poor handwriting. Composition through handwriting was still the norm in classrooms at this time. Once the student's handwriting ability was removed as a barrier to expressing their ideas, they were then able to excel in assessments of writing composition. As this was the 1980's and computers had not yet become a ubiquitous part of our lives and institutions, providing these accommodations to students in the

classroom was difficult and not feasible. It became apparent to Meyer and Rose (2014) that they needed to shift their narrow focus of helping students adapt directly, to helping educators remove the barriers in their learning environments, thus giving them access to the task (CAST, 2011; Meyer & Rose, 2014)

Under the direction of Meyer and Rose, CAST began producing digital books for students with diverse needs. They discovered they could include all of the adaptations different students might need in the same "book," such as high-contrast navigation buttons, text-to-speech for students with visual needs, and linked definitions to words for students with vocabulary needs. Students could turn these options on and off to create an environment that supported them best. Meyer and Rose (2014) began to realize that with appropriate support in place, it was inflexible curriculum that was the problem, not the learners' diverse needs. Meyer and Rose (2014) define "curriculum" as the learning goals, means of assessment, teaching methods, and materials. It was not designed for learner variability and defined by the dominant medium of the time: printed text. Learner variability was seen as a problem. Even more important than the barriers imposed by curriculum itself, the pair were also aware of the affective barriers that arise from rigid tradition curriculum, such as social stigma and feelings of incompetence, that led to a loss of creativity and love of learning for many students they worked with.

These experiences informed the earliest incarnation of UDL in the early

1990's. Meyer and Rose drew upon research from the fields of neuroscience and education science and framed them within the context of Ronald Mace's Universal Design (CAST, 2011). Where UD focused on equity in the physical world, UDL would focus on equity in educational instruction. They mapped the seven principles of UD into the three main principles of UDL which also correspond to the three information networks in the human brain (Tobin & Behling, 2018). The specifics of these principles and networks are provided in more detail in the next section.

There is a distinction that must be made between the terms "framework" and "guidelines." The UDL framework is the overarching, research-based theory proposed by Meyer and Rose. The UDL framework was first represented in book form in their 2002 book, *Teaching Every Student in the Digital Age*. This book outlined the main three principles, the research which informed them, and practical examples and implementation methods. However, it was not until 2008 that CAST released "Version 1.0" of the UDL Guidelines to provide educators with concrete support in applying the UDL framework in practice (CAST, 2020). Based on feedback from educators, CAST revised the UDL Guidelines and released "Version 2.0" in 2011. The UDL Guidelines have received several minor clarification-based revisions since then; the most recent version being "Version 2.2" which was released in 2018 (CAST, 2020). As of this writing, the UDL website mentions that more revisions are in progress to allow UDL to more

directly address diversity, equity, and inclusion. Changes in the framework (theory) and guidelines (practice) will be discussed in more detail in the next section.

UDL has gradually gained more recognition outside of education research and practice circles. In 2008, a definition of the term universal design for learning was included under federal law in the Higher Education Opportunity Act (Miller, 2008). In 2010 and 2017, the U.S. Department of Education's (U.S. DOE) National Education Technology Plan emphasized UDL as a framework that can benefit all learners, particularly those who have been underserved (U.S. DOE, 2017).

UDL Framework Overview

The Universal Design for Learning principles that describe the teaching behaviors and practices which help foster a learning environment in which all learners can gradually move along the continuum from novice to expert learners. (Meyer & Rose, 2014). However, as previously mentioned, Meyer and Rose drew upon research from the fields of neuroscience and education science and framed them within the context of Ronald Mace's Universal Design (CAST, 2011). They mapped the seven principles of UD onto the three main principles that correspond to a model of three information networks in the human brain that together contribute to human learning (Tobin & Behling, 2018). Table 2.2 presents an overview of the UDL framework's principles, their corresponding guidelines, and how they align with the brain's learning networks.

Table 2.2

The UDL Networks, Principles, and Guidelines (CAST, 2018)

Human Brain Networks			
Brain Networks	**Affective (Why)**	**Recognition (What)**	**Strategic (How)**
UDL Framework Principle	Provide multiple means of Engagement.	Provide multiple means of Representation	Provide multiple means of Expression.
Guidelines			
Access	Provide options for Recruiting Interest	Provide options for Perception	Provide options for Physical Action
Build	Provide options for Sustaining Effort & Persistence	Provide options for Language & Symbols	Provide options for Expression & Communication
Internalize	Provide options for Self-Regulation	Provide options for Comprehension	Provide options for Executive Functions
Expert Learners Are...			
Goal	Purposeful & Motivated	Resourceful & Knowledgeable	Strategic & Goal-Directed

Research Foundation of UDL

The UDL framework, principles, and guidelines are not a discrete theory or set of practices on their own. They should rather be thought of as a synthesis of peer-reviewed research in neuroscience that comprises what we know of how the human brain learns and reconstructs it into a set of practice-based directives for educators to apply. In essence, UDL represents the culmination of fifty years'

worth of learning research. While I have been unable to find a detailed,

authoritative account for how UDL was developed, through examination of

Meyer's and Rose's publications (and more importantly, their bibliographies) I

offer my own interpretation of how UDL was created. What follows is primarily

based on their 2002 book, Teaching Every Student in the Digital Age (Meyers &

Rose, 2002), and their 2014 book, Universal Design for Learning: Theory and

Practice (Meyers et al., 2014). For bibliographies organized according to each

specific UDL checkpoint, I highly recommend consulting the Research Evidence

page of the UDL website (CAST, 2022).

The UDL framework and its guidelines are derived from research in the

fields of neuroscience, neuropsychology, and cognitive science. UDL's three

principles of Multiple Means of Representation; Multiple Means of Engagement;

and Multiple Means of Action and Expression align directly with the recognition,

affective, and strategic "networks" of the human brain (Rose & Meyer, 2002).

Figure 2.1 highlights and summarizes these three networks.
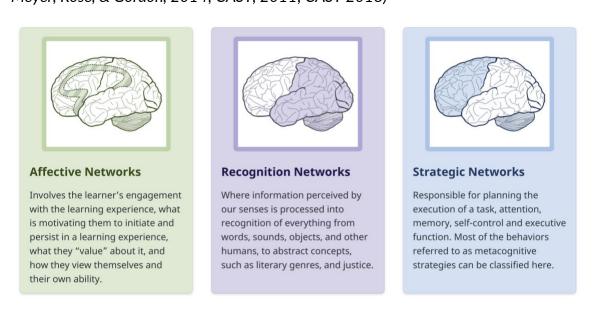
Distinct neural networks are identified through the use of various

neuroimaging technologies. Essentially, researchers provide subjects with stimuli,

or have them perform a task while they are connected to brain imaging hardware

which displays the locations of the brain exhibiting increased electrical activity. It

should be noted that the nomenclature used for the three networks themselves

are constructs used by UDL's authors to group and simplify a much more complex

and granular neural topology described by neuroscience and related fields (Kandel et al., 2012). In other words, while UDL correctly generalizes the functions and characteristics of the brain, it's a simplification of actual complexity. Neuroscience literature would cite many smaller component modules within one of the UDL model's "networks."

Figure 2.1

The Brain Model Underpinning UDL (Derived by author from Meyer & Rose, 2002; Meyer, Rose, & Gordon, 2014; CAST, 2011; CAST 2018)

Affective Networks

Involves the learner's engagement with the learning experience, what is motivating them to initiate and persist in a learning experience, what they "value" about it, and how they view themselves and their own ability.

Recognition Networks

Where information perceived by our senses is processed into recognition of everything from words, sounds, objects, and other humans, to abstract concepts, such as literary genres, and justice.

Strategic Networks

Responsible for planning the execution of a task, attention, memory, self-control and executive function. Most of the behaviors referred to as metacognitive strategies can be classified here.

Despite the necessary reduction in complexity of UDL's central model, Rose and Meyer feel that it is valid, as it is reflected in fields outside of neuroscience. In fact, their model is based around early 20th century psychologist Lev Vygotsky's (1962) three prerequisites for learning: recognition of the information to be learned, strategies to process that information, and engagement with the learning task. Furthermore, the core UDL model is very similar to Bloom's

cognitive, psychomotor, and affective taxonomies of learning domains (Bloom, 1956; Anderson & Krathwohl, 2001). Meyer and Rose used Vygotsky's prerequisites as a scaffold to apply to research in education, psychology, and other related domains to identify findings which aligned with neuroscience research. This effort ultimately led to the UDL Guidelines: a more granular refinement of the framework. The following sections summarize the theoretical basis for UDL's model of how the human brain transforms sensory input into knowledge and subsequently applies that knowledge to its environment.

Recognition Networks

The Recognition networks are UDL's term for various neural modules located in the brain's occipital, parietal, and temporal lobes. These are areas of the brain where information perceived by our senses is turned into recognition of everything from words, sounds, objects, and other humans, to abstract concepts, such as literary genres and justice. The Recognition networks serve to distribute the work of identification across several regions of the brain, giving us the ability to recognize multiple things at once and even categorize and recognize interrelationships between things which are perceived. (Petersen et al., 1988; Rose & Meyer, 2002; Kandel et al., 2012). The recognition networks are the foundation for the UDL Framework's multiple means of representation principle.

Affective Networks

The brain's limbic association cortex is responsible for regulation of emotion and motivation (Rose & Meyer, 2002; Meyer et al., 2014; Kandel et al., 2012) and the focus area of UDL's Affective networks, which is aligned with the UDL Framework's "Provide multiple means of engagement" principle. The Affective networks' role in learning involves the learner's engagement with the learning experience, what is motivating them to initiate and persist in a learning experience, what they "value" about it, and how they view themselves and their own ability.

Strategic Networks

The frontal lobe of the brain houses the systems which are associated with UDL's Strategic networks. This part of the brain is responsible for planning, attention, memory, and self-control (Rose & Meyer, 2002; Meyer et al., 2014; Kandel et al., 2012). The Strategic networks align with the UDL framework principle, "Provide multiple means of action and expression." The Strategic networks' role in learning pertains to how students accomplish tasks, specifically their internal task planning and execution.

Learner Variability

Along with the UDL's model of the learning brain, is its base assumption of learner variability. The brain is a massively interconnected system. While we all share the same general structure within our brain, the way the different networks

are interconnected may vary due to the way those connections are made in our

own unique brain. In fact, the neuroscientific definition of "learning" is a change in

our behavior that results from the acquisition of information collected through

sensory input (Rose & Meyer, 2002; Meyer et al., 2014; Kandel et al, 2012). It is

literally the creation of new interconnections between neurons, the cells of the

brain (Genesee, 2000).

Expert Learning

UDL's core model describing how the human brain functions and learns is

represented by the three primary UDL principles. Those principles are each

further articulated into the nine UDL guidelines, each of which is further

granularized into even more detailed checkpoints. A summary of all the UDL

principles and guidelines can be found previously in Table 2.2 on page 28. A more

detailed listing which also includes the checkpoints for each guideline can be

found in Appendix A. The ultimate result, as claimed by Meyer and Rose, is to

enable everyone to become "expert learners." By Meyer & Rose's definition,

"expertise" is a process rather than a result. It is a lifelong process of trying to

become more motivated, knowledgeable, and skillful. The authors were very

deliberate in the choice of those three words, as they align directly with the UDL

network model and principles; Affective, Recognition, and Strategic, respectively.

The underpinnings for UDL's conception of expertise are informed by research in

expert studies. Expertise is influenced through practice, exposure to good

teachers, and self-direction, rather than inherent characteristics, such as genetics.

(Chi et al., 1988; Ericsson & Smith, 1991). Expertise is also domain specific

(Ericsson, 1998), meaning that a person may be an expert at cooking, but a novice

at playing the guitar. In the context of UDL, "learning" is the domain it is trying to

influence expertise in. Experts also have a set of strategies, behaviors, and

knowledge areas they have been taught in order to become experts. By creating

the UDL framework and guidelines, Meyer and Rose synthesized numerous

effective teaching techniques, organized them into neurologically-aligned

categories, and ordered them in a way that reflects how experts achieve mastery.

This ordering can be seen in CAST's UDL Guidelines organizer, and in Table

2.2 of this chapter (page 28). The first "Access" tier of the guidelines are the

guidelines, aligned to their parent principles. These guidelines are to help

educators create learning experiences that include novice learners at the start,

such as employing engagement strategies to grab their attention, providing

materials in multiple modes, and ensuring that materials do not interfere or

prevent students' use of assistive software and devices. The access tier essentially

contains the guidelines which many educators associate with accessibility. It is

this tier of guidelines, and UDL's origins in the field of special education, that have

led to the common misconception that UDL is solely an accessibility framework

specifically for learners with disabilities. In actuality, UDL is a teaching framework

that synthesizes fifty years of cross-disciplinary research into a set of evidence-

based teaching strategies. There are other, more specialized tools and standards for accessibility, such as the World Wide Web Consortium's Web Content Accessibility Guidelines (W3C, 2018) which describe in fine detail how to make digital content, such as web pages, more accessible to people with disabilities.

Once an educator has gained the attention of their learners with rich content, and interesting engagement strategies, the guidelines and checkpoints of the "Build" tier are designed to help maintain that interest and give them tools to keep going. Some examples include regularly reminding learners of the "big picture" of the content they are learning and why it matters, providing them with convenient content references to augment their memory, and not restricting them to a specific means of expression when mastery of a course objective can be expressed in another way the learner is more comfortable with.

Finally, the "Internalize" tier shown on Table 2.2 represents the point where the educator transfers ownership of learning to the learner. It is where expert learning is realized, as the learner is given tools to reflect upon their work, set goals for the future, plan out a path to reach those goals, and use what they know to create new knowledge.

Other Instructional Applications of Universal Design

Inspired by the core principles of UD, there arose a number of frameworks pertaining to education that can be used to guide the creation of courses in all modalities, instructional materials, assignments, and learning experiences. The

three most well-known in this domain are Universal Design for Learning (UDL),

Universal Design for Instruction (UDI), and Universal Instructional Design (UID).

Fundamentally, all of these are compatible with each other and are considered

implementation of UD standards. The research outlined in this proposal focuses

specifically upon UDL due to its versatility and relative prominence in the existing

literature.

Synthesis of UDL Research in K-12

Crevecoeur, Sorenson, Mayorga, and Gonzalez (2014) conducted a

literature review of UDL-focused research in K-12 settings from 1984 through

2014. They selected articles based on evidence-based practices including the use

of randomized or quasi-experimental groups, regression-discontinuity, or single-

subject research methods. They also screened based on the use of UDL in the

design of instruction in the K-12 setting. This resulted in five studies which met

their stringent criteria. Despite the small size of the resulting pool, they found that

the studies supported the incorporation of UDL in the design of instruction in the

K-12 setting. However, they noted that both educators and researchers must use

caution in how they apply the UDL principles, guidelines, and checkpoints. All

studies emphasized that the term 'universal' should not be interpreted as meaning

"one size fits all." Instead, it should be treated as a conceptual shift to meeting the

curricular and instructional needs of the widest range of learners. Researchers in

the selected articles tried to incorporate as many of the UDL guidelines and

checkpoints as possible, but often avoided specifying precisely which ones.

Ok, Rao, Brian R. Bryant, and McDougall (2017) reviewed thirteen articles in the pre-K-12 setting pertaining to UDL published between January 2000 and December 2014. None of the articles in the review used random selection of participants, and five used a quasi-experimental design. Ok et al. (2017) attributes the lack of true experimental studies to the relative newness of research involving UDL interventions, and as such, the field is still in the process of defining what comprises a UDL-based intervention and establishing standards for reporting. Therefore, the authors recommend the use of random assignment in UDL group studies to improve validity and enable clearer evaluation of UDL interventions. In their view, UDL studies remains an emerging field of research. The wide array of methods used to apply UDL in the reviewed studies prompted Ok et al. to recommend that researchers clearly describe how they applied the UDL guidelines in their intervention efforts. Rao, Ok, and Bryant (2014) reached a similar conclusion in their literature review of studies that spanned multiple UD-based frameworks across pre-K through postsecondary settings. They recommended that researchers describe in detail how their interventions and their components align with specific UDL guidelines and checkpoints. Alignment of practices to the UDL framework will help other researchers design replication studies to evaluate the components of UDL-based interventions that are effective. Overall, Ok et al. (2017) conclude that UDL-based instruction has

potential to meet the academic needs of diverse learners. However, the efficacy of UDL-based instruction and student academic outcomes varied widely among the studies included in their review.

Finally, Saifon (2021) reviewed four UDL-focused studies in the K-12 setting and argued that the conditions for each study constituted unique, unrepeatable phenomena which lead to findings that can only exist in certain circumstances. They reached the same conclusion as Crevecoeur et al. (2014), Rao (2014), and Ok et al. (2017). Researchers must be very clear and specific regarding the alignment of their interventions with UDL and test specific parts of the framework rather than treat it as a whole.

UDL Research in Postsecondary Education

While UDL has been adopted frequently both institutionally and individually by teachers in K-12, it is much less common at the postsecondary level, and even less common when the scope is reduced to online learning. My review efforts were only able to locate 14 published papers pertaining to online pedagogy in postsecondary education. This scarcity motivated my choice to also include articles that pertained to UDL and postsecondary curriculum of any modality which added an additional 17 articles to the pool. I consider this group of 14 articles to be the "core" set of literature most relevant to my proposed research and is the focus of this section.

Within the core set of UDL and postsecondary-focused literature, I

established further categorization based on research methodology and organized

these methodological categories based on their relevance to my own vision for

this dissertation. Additionally, articles whose dependent variable, or subject

involved some student-focused outcome or metric were of the highest relevance.

The order of this prioritization is detailed below:

1. Mixed Methods with inferential quantitative analysis of student outcomes.

2. Qualitative case study based on a complete course design process and first

   term run of a course.

3. Inferential quantitative analysis of student outcomes.

4. Qualitative interviews of students.

5. Mixed Methods with a descriptive quantitative analysis of student

   outcomes.

6. Articles of any methodology which did not examine student outcomes in

   any form.

7. Non-empirical articles which only advocate and/or provide information

   regarding UDL.

My use of "priority," should not be equated with an opinion of importance

within the field, but rather my own interest in finding studies similar to the one

outlined in this dissertation. As discussed earlier, the articles pertaining to UDL in

the postsecondary arena are composed of two sub-groups. Those which pertain

to face-to-face instruction, and those which pertain to online or blended

modalities. The articles in the first subset range between 2005 through 2019 with

one or two being released nearly every year. 2008 is when the first study

pertaining to online learning appears. The appearance of UDL articles focusing on

online learning also coincides with a weak increase in the number of publications

per year.

Taken as a whole, the core group of postsecondary UDL literature is

dominated by articles advocating its usage (Dalton et al., 2019; Dell et al., 2015,

Hollingshead & Carr-Chellman, 2019; Oswald et al., 2018; Robinson & Wizer,

2016; Rogers et al., 2018; Rose et al., 2006; Sapp, 2009; Tobin, 2014). While

many of these are excellent articles for their role, they are not useful as empirical

evidence of UDL's effectiveness at the postsecondary level. Excluding those, we

are left with 22 articles containing actual empirical research. In terms of

methodologies, these are spread somewhat evenly across inferential and

descriptive quantitative, and mixed-methods with inferential analysis.

Figures 2.2, 2.3, and 2.4 illustrate the division of methodologies among the

articles collected for this literature review. Looking at the two subgroups

separately reveals that the research involving face-to-face courses carry most of

the quantitative studies, while the online group is responsible for the population

of non-empirical, advocacy-focused articles. If the sparsity of empirical research in

the group as a whole were not quantitative justification for this proposal, its rarity

in the online learning subset, those most like this proposal, certainly is. Excluding

the non-empirical advocacy articles, we are left with 15 core articles focusing on

UDL in a face-to-face classroom setting, and 7 in an online or blended setting. The

remainder of this section will examine these in detail.

Figure 2.2

Total Articles by Methodology
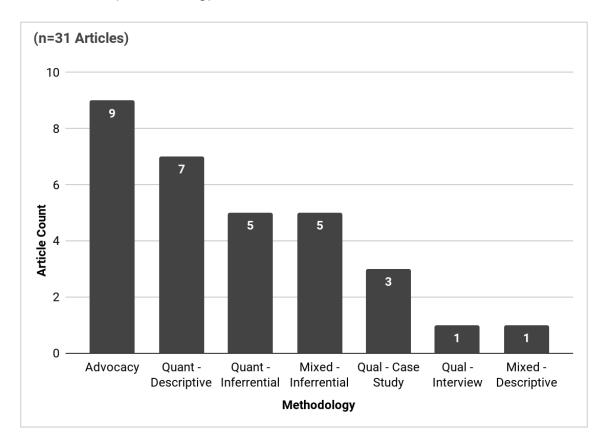
Figure 2.3

Face-to-Face Articles by Methodology
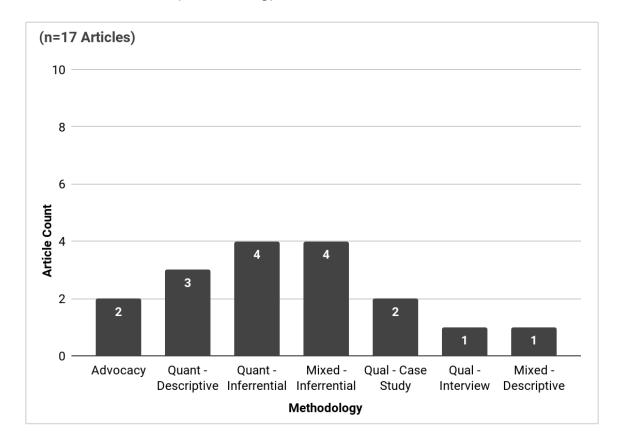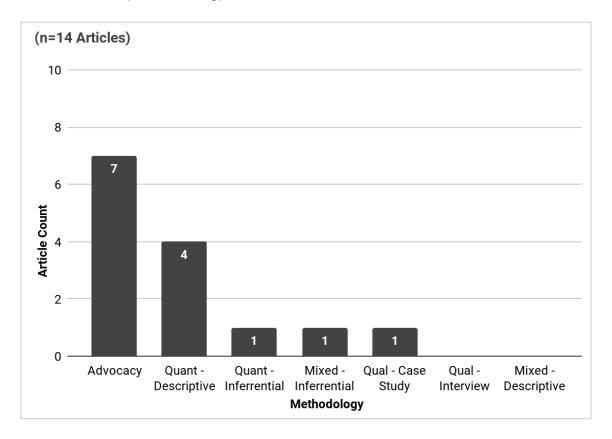
Figure 2.4

Online Articles by Methodology

Face-to-Face Classrooms

Among the set of articles that included inferential quantitative results in an experimental setting, UDL modifications consistently led to statistically significant results across several student-focused dependent variables. Of particular interest are studies that directly measured student performance and perceptions. The quantitative portion of Beckman et al. (2009) took two sets of measurements across a control and a treatment group. The first set involved a survey of the participating students which yielded a statistically significant finding that more

students in the treatment group held the perception that their instructor was more open to a variety of points of view. The second set of measurements related to performance. Students in the UDL treatment group scored higher than those in the control group on parts of an exam assessing material covered during the experiment. This indicates that the UDL activity enhanced students' understanding of the material by varying the ways in which it was presented to them. However, Beckman notes that the small-group discussion UDL intervention the study centers around was only conducted in 5 of 15 class sessions which likely limited their effect on students' graded assessments.

Student-Focused with Quantitative Measurements.

This category of study includes those which focused on the use of inferential statistics to analyze the effect a UDL intervention had on a measurable student outcome. Basham et al., 2010 performed a t-test comparing course evaluations of instructors who had implemented UDL-aligned design choices into their courses. They found a positive, statistically significant result, however the authors noted that the actual reason for the changes seen in instructors' evaluations, could not be attributed to the UDL-based design choices made in the course. The quantitative portion of Beckman, 2009's mixed-methods study investigated the effect of adding a UDL-aligned, small-group discussion to a face-to-face lecture course of students without disabilities. The quantitative portion contains two measurements, the first being a survey of students who took part in

the study. The only statistically significant finding from that survey is that more students in the treatment group had the perception that their instructor was more open to a variety of points of view. The second measurement pertained to exam scores related to the activity. The UDL treatment group scored significantly higher on portions of the exam that pertained to the material covered in the small group discussion. This indicates that the UDL activity enhanced students' understanding of the material by varying the ways in which it was presented to them. Smith (2012) examined the impact of a UDL course over several semesters and collected both quantitative and qualitative data. The researchers found a statistically significant increase in student engagement and supports the view that UDL enhanced coursework increases student engagement, however, as with other studies in this field, it had a small sample size. Schelly et al. (2011) measured effectiveness of a faculty UDL training by pre and post surveying students. There was a statistically significant increase in the use of UDL by faculty. However, It did not measure student outcomes, just student's perceptions of their instructors. Dean et al. (2017) implemented UDL-based design elements into an in-person lecture course which included in-class clicker devices and out-of-class online interactive practice activities. They found a statistically significant positive impact on perceived learning; satisfaction with the instructional tools; and actual learning, while also having a large sample size (n=600). They also made several demographic observations. Women tended to prefer a greater variety of tools and

were more engaged with the course material than men. They also observed that

people of color are more likely to actually use clickers, the in-class modification,

but less likely to use the out-of-class online practice activities. These findings

support the use of various instructional tools to reach an increasingly diverse

student audience that more fully include women. While the setting of this study

was technically an in-person course, the tools available to students in the study,

particularly the ones showing the most positive effects, were those that students

interacted with outside of the classroom through the institution's LMS, therefore I

consider them to be relevant to the online setting as well.

Student-Focused Qualitative.

Studies in this category measured student outcomes after a UDL

intervention using interviews, surveys, and other qualitative methods. Kumar &

Wildman (2014) is a case study of a single first-year undergraduate course

designed around UDL principles. Overall, the undergraduates found it to be a

positive experience. Kumar and Wildman cite increased flexibility, social presence,

reduced stress, enhanced success, a sense of control over their own learning

process, and empowerment to choose the ways that best support their learning.

The experience was also satisfying to the instructor.

Black et al. (2015) performed phenomenological interviews with 15

student participants investigating the perspectives of students with and without

disabilities as they relate to faculty instructional methods. They also explored how

conducive those methods were to students' learning and how those methods

align to UDL/UDI. Themes that were consistent between students with and

without disabilities included a desire for achievement, the importance of

communication and feedback between student and professor or among students,

connections of ability to relate the materials presented for class to learning

accomplished by students, equality issues related to either access to class

materials or how students are treated in class; support (from faculty and

departments on campus), and reassurance that tools are available to help students

achieve.

Some themes were discussed by students with disabilities more often than

by students without. These themes related to the importance of organizing the

physical environment (11 students with disabilities and 2 without) to be

conducive to learning and equity issues related to how students are treated

compared to students without disabilities (9 students with disabilities and 1

without).

Other themes exclusive to students with disabilities were familiarity, or

lack of familiarity in working with students with disabilities regarding faculty and

staff (n=11), frustration with accommodations and school policies (n=9), and

stigma related to disabilities (n=7) such as psychiatric or learning disabilities.

Stress was another major theme. This related to additional concerns faced by

students with disabilities but not by other students, such as having to rely on

disability service staff to administer some accommodations, as well as stress from the extra time it takes to study (n=6) and even transportation issues (n=1).

The qualitative portion of Beckman (2009) found that the students in the UDL treatment group who preferred group discussion were better served by this activity than a standard lecture. Beckman also notes that the activity broke up the constancy of the class and that, behavior-wise, the students were more lively, animated, and enthusiastic. Furthermore, during the lecture portions, only a few students would offer responses. This is in contrast to the group-discussion portions where nearly all students were participatory. Finally, after the group-discussions, students appreciated sharing their group's work with the rest of the class, and were more able to pay attention during class due to the fact that the instructor aggregated all the group responses together into a presentation to be posted online.

Faculty-Focused Qualitative.

These studies focused specifically on faculty outcomes using qualitative methods, and/or descriptive statistics. These studies all utilized surveys to perform their research. Izzo et al. (2008) performed two sequential qualitative studies to examine faculty perceptions, experiences, practices, and needs surrounding students with disabilities. The first was a survey sent to 1150 subjects and 270 responses were received. The second study was a phased set of interviews (n=63, n=35). Overall, UDL was the preferred desired training topic.

Subjects expressed a need for training in UDL and meeting student needs, and that the research efforts almost universally increased their knowledge of UDL. Lombardi et al., (2015) executed a large (n=1500) international study which measured faculty attitudes regarding UD-related instructional practices. They found that while faculty have positive perceptions of such frameworks, far fewer are implementing them. Westine, et al., (2019) distributed a survey to gauge faculty knowledge of UDL. They received 150 responses to their survey, with 71% familiar with at least one UDL principle.

Pre-Service Teacher focused.

A popular setting for research pertaining to UDL is among pre-service teachers. In a controlled study, Spooner et al. (2007) found that providing a 1-hour session on UDL to pre-service teachers enabled them to develop lesson plans that served students with mild or severe cognitive disabilities. These results suggest that providing information and training on UDL would be an effective way to develop lesson plans for all learners in all environments. They performed a multi-factor ANOVA with repeated measures for the dependent variables of total test score, representation, expression, and engagement scores. On the lesson plan pretest and posttest scores for the control and experimental groups, they found that the teachers in the experimental group improved in their lesson plan development. McGhie-Richmond and Sung (2013) expanded upon Spooner (2007) by giving pre-service teachers the opportunity to revise existing lesson

plans after receiving instruction on the UDL principles. The pre-service teachers in the study made significant revisions to their lesson plans as a result of the UDL instruction they received. McGhie-Richmond and Sung concluded that their study further validates UDL as an effective means to empower teachers to adapt their lessons for all learners. McGuire-Schwartz and Arndt (2007) is a case study of pre-service teachers being introduced to UDL in their college classroom. The subjects in the study learned new teaching practices by virtue of UDL, however found that a lack of available technology and software in the schools was a barrier for the student teachers to implement UDL in their classrooms. The subjects in Zhang (2005) made inefficient use of devices for instruction because of a lack of skills in technology, but also noted that collaboration is essential to developing these skills. Teachers' valued how assistive technology helped their students with different learning backgrounds, but noted that adequate amounts of practice would be needed to generalize their technology knowledge in different contexts. Courey et al. (2012) performed a quantitative study similar to Spooner (2007) in which a treatment group of pre-service teachers were given instruction on UDL and then asked to produce a lesson plan. A statistically significant improvement in lesson plan design by pre-service teachers was observed. The lesson plans of those students in the treatment group contained more differentiated options and varied teaching strategies.

UDL in Postsecondary Online Learning

Student-Focused Studies Leveraging Quantitative Measures.

The studies described in this section took place exclusively in an online course as their setting and measured one or more student outcomes using inferential statistics, or statistical modeling. Al-Azawei et al. (2017) measured students' (n=92) perceived satisfaction and behavioral intention between a control and experimental course treated with UDL-based design elements. They applied partial least squares-structural equation modeling (PLS-SEM) using the technology acceptance model (TAM). The model accounted for 45.4% and 41.6% of the variance of perceived satisfaction and behavioral intention, respectively. In other words, students responded positively to the UDL-based elements. Al-Azawei et al. cite Bolliger and Wasilik's (2009) concept of Perceived Satisfaction and their assertion that student dissatisfaction leads to them withdrawing from courses or weaker performance. Adding UDL elements increased this satisfaction. In particular, students found that videos were most useful when they explained the course outlines (76.1%); details of the lectures content (73.9%); overview and goals of lectures (72.8%); and summary of lectures (71.7%). They conclude that instructors should integrate multimedia into the design of courses rather than using e-learning as a medium of uploading textual materials only.

In He (2014), The three principles of UDL were applied in an online course. Pre and post surveys, as well as open-ended questions, were used to measure

learner perceptions of the importance and their satisfaction with various course components. Participants (n=24) indicated their satisfaction with the course and how it helped to improve their self-efficacy and confidence in online learning. The qualitative portion of the study isolated a number of themes at the start of the course. 58% of the subjects expressed concern about online learning, specifically the lack of interaction with peers, and was the most prevalent theme. Next, 28% of participants expressed concern over interaction with the instructor. He (2014) also notes a lack of students commenting about technology. Only one student expressed this concern. Many students expressed a decrease in these concerns when asked again at the end of the course. While this study claims to base its analysis of the data upon UDL, the "EnACT" rubric used within it only seems loosely based on the UDL guidelines in that the study provides few details on the process used to create it. Based on the rubric itself, there appears to be little direct alignment to the UDL framework at all, other than a few cursory mentions.

Dallas et al. (2016) focused specifically on the addition of captions to videos in an online course. Undergraduate students who watched the video with captions demonstrated a statistically significant increase in their comprehension of the video compared to students who watched the same video without captions.

Student-Focused Qualitative & Descriptive Statistical Studies.

Studies in this category measured student outcomes in an online course

setting after a UDL intervention using interviews, surveys and other qualitative

methods and/or included descriptive statistics. Nieves et al. (2019) observed an a

priori relationship between the inclusion of UDL elements and an increased

Massively Open Online Course completion rate of 27% over the standard

completion rate of 10%. Rao et al. (2015) conducted a case study which included

a survey (n=70). They utilized a synthesis of several instructional UD

implementations which included UDL, to design an online course. Results yielded

positive perceptions of the course modifications by students. However, Rao et al.

admit that since these results are self-reported by students, they do not

necessarily translate to an empirical increase in student performance. Like Rao et

al. (2015), Trust and Pektas (2018) also performed a case study with a post-action

student survey (n=53). While the modified course received positive reviews from

students, the study suffered the same weakness as Rao et al. 2015. In addition,

there was no way to determine if those students' perceptions could be attributed

to the UDL design elements added to the course. Scott and Temple (2017)

performed a case study with no measurements or data collection to speak of.

They discussed the interconnection between special education pedagogy, online

pedagogy, and the UDL Guidelines. They describe how they applied the

guidelines in an online course; however, it lacks any indication as to how effective

these efforts were in helping students meet the course objectives and indication

of their perception of the learning environment.

Lohmann et al. (2018) is a case study with qualitative measures in an online

teacher preparation course. Due to the small number of studies taking place in

online postsecondary courses, I elected to include this one, rather than categorize

it with the studies focusing on pre-service teachers. Additionally, its focus on the

effect on student outcomes by UDL-aligned modifications is more in line with the

goals of this study, as opposed to many of the studies in the pre-service teacher

category, which primarily focus on instructing pre-service teachers and measuring

their experience applying UDL in the classroom. Lohmann et al. (2018) included

many optional components for engagement in the courses in the study, such as

opportunities to connect with instructors through virtual office hours via online

video conferencing, Twitter, and even offering to call students prior to the start of

class. Students were provided with guides and supports for these engagement

tools as well. When surveyed, many of the students verified that they were aware

of these engagement options, however few leveraged them. The modification

that presented substantial regular usage, at 42% of students, were those of phone

calls and text messages to contact the instructor. Students participating in the

survey noted that the engagement strategies the authors employed helped them

feel more connected to both the course professor and to other students in the

course. Lohmann et al. cite this finding as validation of Deschaine and Whale

(2017), which found that online students value instructors they view as present and accessible.

Research Pertaining to Other UD-Based Teaching Frameworks.

A handful of studies were found pertaining to postsecondary education and online learning that used other instructional implementations of Universal Design. However, some of this work varies in rigor and trustworthiness. Most are case studies or based on surveys with few details on data collection practices. Fidelity is lacking. In one case study, Burgstahler (2004) found that both faculty and students benefit from an environment where UD and accessibility principles are a core part of the institution. Furthermore, these benefits were not limited to students with disabilities. However, this study seemed more like a set of guidelines, rather than a thorough data collection effort.

Wynants and Dennis (2017) performed a more thoroughly documented study using Universal Design for Instruction (UDI) as its conceptual framework. 43 faculty members participated in a training on UDI and filled out surveys before and after. The qualitative and quantitative findings from this survey showed that participating in the training improved faculty knowledge, attitude, and confidence in applying UDI principles for better accessibility of course materials and content presentation.

In a study of sixteen postsecondary disability service providers, Embry, Parker, McGuire, and Scott (2005) explored the strengths and weaknesses of UDI.

Two focus groups were conducted. The groups agreed that UDI could improve the retention and recruitment of a more diverse group of students at their respective institutions, support the empirical scholarship of university teaching, and reduce the stigma associated with people with disabilities. However, a major shift in institutions' culture and policy would be needed to realize these benefits. Institutions with a strong culture of incentivising research over teaching would be particularly difficult to change. Other more general weaknesses they noted were faculty resistance, training and technology requirements, the service providers' own lack of expertise in instruction, and lack of a legal mandate to implement UDI. I feel compelled to note that these weaknesses are not really UDI's, but are rather the reality of postsecondary education in the United States. They challenge any effort or framework aimed at improving student outcomes, UDL included.

A study conducted by Parker, Robinson, and Hannafin (2007) involved pre-service teachers in a required special education course that was redesigned using UDI. Qualitative data were collected from online student comments in the course, as well as from comments and scores provided on the institution's course evaluation forms. students expressed general satisfaction with the redesigned course, appreciation for the various instructional technology additions made to it, such as downloadable slide presentations made available before each class. They also noted the availability and responsiveness of the course instructor.

Street, Koff, Fields, Kuehne, Handlin, Getty, and Parker (2012) conducted a study on improving the inclusion of students with disabilities in STEM courses. The Peer-Led Team Learning model (PLTL) is used commonly in STEM courses to promote student success, however the researchers observed that students with disabilities did not succeed as often as their peers without disabilities. They attempted to address this by modifying the PLTL model through the use of UDI. Students with disabilities participating in the study noted a high degree of satisfaction with the experience with a noted improvement in their persistence through STEM coursework. The study's participants also identified several barriers in STEM coursework, such as class size, which limits opportunities for asking questions; the cumulative nature of STEM curricula; the specificity of STEM content.

Chapter 2 Summary

This literature review explored the origins, features, and structure of the Universal Design for Learning framework and guidelines. It also systematically collected and reviewed the current state of UDL literature as it relates to postsecondary, online course environments, and summarizes other related areas, such as UDL research in the K-12 arena, and studies which pertained to other UD-based teaching frameworks, such as UDI.

Five themes regarding the body of scholarly research were derived from this review which in turn guided the design of this study's methodology. These

will be referred to as "research themes" from this point on to distinguish them from other uses of the word 'theme' in this dissertation. The first three research themes emerge repeatedly from the literature itself. The other observations about the literature were made through the process of examining and writing about these studies. First, is the literature's documented need for more empirical research on UDL's effect on student outcomes (Basham et al, 2010; Davies et al., 2013; Izzo, et al., 2008; Kennedy et al., 2014; Seok et al., 2018; Spooner, 2007; Westine et al., 2019). Second, is the lack of research which incorporates experimental comparison with control and treatment groups (Basham et al., 2010; Davies et al., 2013; Izzo et al., 2008; Kennedy et al., 2014; Seok et al., 2018). Third, is the need to be clear and specific regarding the alignment of researchers' interventions that apply UDL and to test specific parts of the framework, rather than treat it as a single entity (Crevecoeur et al., 2014; Ok et al., 2017; Rao, 2014; Saifon, 2021).

The fourth and fifth research themes are the result of my own observations of the current literature. There is an absence of in-depth phenomenological, qualitative exploration of the instructors' experiences learning about and applying UDL's principles. There are a handful of studies focused on faculty impact and opinions of UDL and other UD-inspired learning and instruction frameworks, but the instructors' processes of learning, applying, and reflecting are generalized without nuance, or simply omitted. Finally, there is also

an absence of published studies which explore or evaluate a model for instructors

to learn and apply UDL in practice, either independently or through collaboration

with an instructional designer or learning designer.

Chapter 3: Methodology

This study explores UDL as a multi-purpose tool for engaging postsecondary faculty in a discussion about improving the student experience in their courses, addressing identified learning barriers, making course modifications and improvements, and as a framework for qualitative data analysis of student outcomes. Its design is informed by a review of the literature of UDL's application in all postsecondary modalities, as well as some of the foundational research which preceded UDL and formed its theoretical underpinnings. This study addresses two research questions:

- *Research Question 1: How does guided engagement of UDL change instructors' perception of their students, courses, and practice as an educator?*

- *Research Question 2: How does the addition of UDL-driven course modifications affect students' perceptions, work, behavior, and whether their learning needs are met within an online course?*

Furthermore, this study attempts to answer these research questions using a design informed by the five research themes that were the outcome of the literature review. Recall that the first three themes are conveyed directly in multiple articles. The last two are my own observations made through the literature review process:

1. The need for more empirical research on UDL's effect on student

outcomes (Basham et al, 2010; Davies et al., 2013; Izzo, et al., 2008; Kennedy et al., 2014; Seok et al., 2018; Spooner, 2007; Westine et al. 2019).

2. The lack of research which incorporates experimental comparison with control and treatment groups (Basham et al, 2010; Davies et al., 2013; Izzo et al., 2008; Kennedy et al., 2014; Seok et al., 2018).

3. The need to be clear and specific regarding the alignment of researchers' interventions that apply UDL and to test specific parts of the framework, rather than treat it as a single entity (Crevecoeur et al., 2014; Ok et al., 2017; Rao, 2014; Saifon, 2021).

4. There is an absence of in-depth phenomenological, qualitative exploration of the instructors' experiences learning about and applying UDL's principles.

5. There is also an absence of published studies which explore or evaluate a model for instructors to learn and apply UDL in practice, either independently or through collaboration with a teaching and learning professional, such as an instructional designer or learning designer. The methodology detailed in the next chapter will attempt to address all of these research themes.

Methodological Overview

Due to the complexity and interconnectedness of this study's mixed-methods design, this chapter is organized as follows to ensure clarity for the reader. After the initial methodological overview and setting information, this chapter details the general, repeated data collection and analysis protocols which were used in the study. Following that, the methodology is described chronologically in "stages" which detail each stage's instrumentation, necessary deviations from the general protocols, and additional protocols specific to that stage. Table 3.1 provides an overview of the entire methodology. The rest of this chapter provides in-depth details on how each stage was conducted.

Table 3.1

Overview of the Study's Methodology

Stage	Description
Stage 1: Instructor Selection	Purposeful, non-random sampling protocol using a Selection Survey distributed to the home institutions' faculty.

Stage 2: Onboarding & First Two Instructor Interviews
   a. Introductory Engagement
   b. First Instructor Interview
   c. Second Instructor Interview
	Onboarding of participant instructors and qualitative collection of data through semi-structured, in-depth interview series.

Stage 3. Course Modification
   a. Course Modification Proposal
   b. Implementation of Course Modifications
	One-on-one meetings to discuss the instructors' respective courses and their responses to the selection form to identify an area of their course to modify. A list of things to change is produced and then implemented in the treatment section of the course.

Stage 4. Student Data Collection
  a. Student Survey Instrument
  b. Other Student Data Sources
  c. Preliminary Student Data
      Analysis
	As each control and treatment course section nears completion, a survey is administered to students about their experience relating to the areas of the course which were modified. This and other data relevant to the modified portions of the course are collected and a preliminary analysis was performed to inform Stage 5.

Stage 5. Third Instructor Interview	A third instructor interview is performed. This interview is integrative in nature, in that the instructors are provided with the results of the preliminary analysis to inform the interview protocol and be used as an item for discussion during the interview.
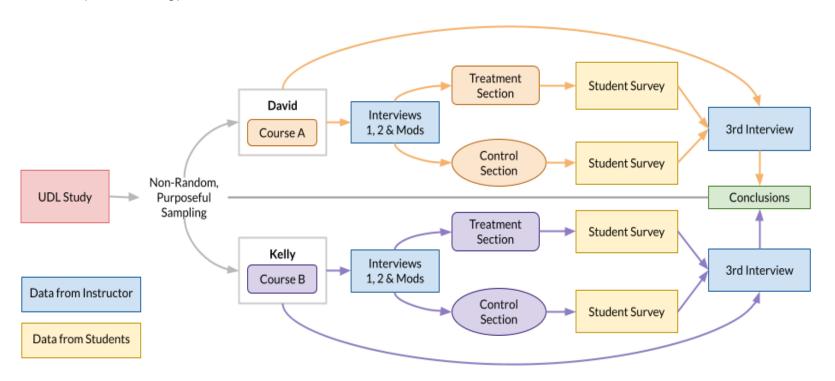
Stage 6. Data Analysis
  a. Instructor Data Analysis Protocol
  b. Student Data Analysis Protocol
  c. Individual Course Analysis
      Protocol
  d. Summative Analysis Protocol
	All data is collected at this point. Quantitative analysis is performed on the fixed-response items in the student survey and other appropriate student data collected. The instructor interview transcripts are corrected, annotated, and coded. Open-response questions from the student survey undergo qualitative coding analysis. All of the data originating from a course is considered holistically to form an impression of the outcome of the course modifications on both the students and instructors. All the study's data is then considered as a whole to address the research questions.

Figure 3.1

Study Methodology Flowchart

This study utilized a sequential, exploratory, mixed-methods approach to thoroughly document and analyze the experience of two postsecondary instructors and the students in their respective courses. The first research question is instructor-focused. It involves instructors working with a learning designer (the researcher) to improve an aspect of one of their online courses through the application of the UDL framework and guidelines. Students then experienced the product of this collaboration; generating the qualitative and quantitative data to address the second research question.

The "instructor-focused" activities for this study were framed by the following research question: "How does guided engagement of UDL change instructors' perception of their students, courses, and practice as an educator?" Addressing this question involved an action-research engagement with a pair of instructors. The instructors selected for the study participated in a brief introductory engagement on UDL. Each instructor was then made the subject of an in-depth interview series (Seidman, 2006). The weeks in-between interviews were perforated by semi-formal "work sessions" to identify an aspect of their online course to modify, and to implement those modifications. A discussion of the qualitative and quantitative data from the second "student-focused" research question was one facet of the final interview in the series.

The second research question focuses on the student experience and was framed as follows: "How does the addition of UDL-driven course modifications

affect students' work, behavior, and whether their learning needs are met within

an online course?" The data collection and analysis performed to address this

question utilized a quasi-experimental approach across two courses. Each course

consisted of an unmodified "control" course section and a "treatment" section

with the modifications its instructor had selected. Quantitative data were

collected through a survey focusing on students' background, their perceptions of

the part of the course modified through a UDL lens, the social validity of the

course modifications, and finally the students' perceived learning needs.

Qualitative data were also collected in the form of UDL-aligned open response

questions paired with the quantitative ones in the student survey. In addition to

student survey data, other relevant quantitative data were collected in the form

of grades on the modified course activities, discussion posting statistics,

assignment posting methods, and resource access.

Sample & Setting

The online courses selected for this study were offered at a medium-size

public university with a full-time enrollment of around seven-thousand. The

courses were fully online and asynchronous. Course A had occasional, informal,

optional, unscheduled synchronous work sessions using the video-based

communication software, Zoom (https://zoom.us). These meetings were not

relevant to the aspect of the course this study focused on. Purposeful sampling

was used to select the two instructors and their total of 46 students between

them. The selection protocol is detailed in the section, "Stage 1: Instructor

Selection" below. The choice of two instructors for this study was deliberate to

ensure the study would be feasible to complete within an eight-month period,

though this methodology could be scaled up to include more instructors should

other researchers choose to replicate it, so long as the time scale and number of

researchers was scaled up along with it. Selection yielded two instructors. The

first, given the pseudonym "David," had an undergraduate online Engineering

course we focused on. The second instructor, given the pseudonym "Kelly," had

an online graduate Nursing course. For the duration of this study, David's course

is referred to as "Course A" and Kelly's is "Course B." Full details about these

instructors and their courses can be found in Chapter 4.

Research Workspace & Log

The "Research Workspace" is an online repository to house and organize all

the digital assets produced during the research activities of this study. All data

collected over the course of this study, including recorded interviews, coding

sheets, and quantitative data were housed in an access-restricted "Shared Drive"

in Google Drive (https://drive.google.com) dedicated specifically for this study

and protected from data mining through the Institution's software license

agreement with Google. Only myself and the dissertation committee chair had

access. This storage area will be referred to as the "research workspace" for the

remainder of this dissertation.

This dissertation's complex methodology, a timeline that often oscillated between sequential and concurrent, and the large number of digital files produced through research activities, demanded a means to track all of these digital assets and events. I established a research log at the start of the participant selection stage. The research log itself is a Google Spreadsheet in a date-keyed format with columns for date, time, event-type, notes/observations, and links to relevant documents in the Research Workspace. A version of this log (with links removed) can be found in Appendix J. This log fulfilled the following roles:

- General organization of research activities.

- A timeline of major steps in the research process.

- A trustworthiness measure to prevent memory bias later in the study.

- A place to record observations made in situ during research activities, such as interviews.

- A central repository of links to collected data and analysis assets, such as transcripts, coding sheets, etc.

- A workspace for rough ideas and insights for future development.

Stage 1: Participant Selection

The goal of Phase 1 of the study was to identify interested and viable instructors through an online survey distributed via email to the institution's faculty. Aside from collecting information about the instructor and a course they desired help with, the survey contained a "Plus-One" exercise. Tobin and Behling

(2018) promote the usage of the "Plus-One" approach as a way to handle the complexity of UDL and prevent instructors from feeling overwhelmed or compelled to change their entire course at once. The Plus-One approach invites instructors to focus on a single context-relevant issue in the course, apply UDL to it, and successively iterate, as opposed to attempting to revise the entire course at once. Rather than requiring instructors to immediately engage with the UDL framework, this exercise provides an intuitive, inquiry-based entry-point into UDL.

Another advantage of the Plus-One approach is that it does not treat UDL as a course evaluation "checklist," such as Quality Matters. Instead, Tobin and Behling (2018) encourage the use of UDL as a "mindset" to examine and refine the way we teach by making student-driven choices available in the way they consume course media, demonstrate their knowledge, and the means in which they engage. It is this availability of choice which enables students, with their very individual characteristics, to select the paths which most closely align with their strengths.

The three questions in the Plus-One exercise are the core of the initial Participant Selection survey, which can be found in Table 3.2. The first part of the instrument filters out respondents as they provide answers that do not meet the first three selection criteria outlined in the *Participant Selection Analysis* section.

Table 3.2

Participant Selection Questionnaire

Participant Selection Questionnaire

Participant Filtering Questions

PQ1. Please select the option which applies to you:
   a) I am teaching simultaneous or consecutive sections of the same online/blended course during the Spring 2021 term and both sections are the same length.
   b) I am teaching simultaneous or consecutive sections of the same online/blended course during the Summer 2021 term and both sections are the same length.
   c) I am teaching a single section of an online course during the Spring 2021 term and then again during Summer 2021. Both sections are the same length.
   d) Neither of the above apply to me.
      [Selecting this option courteously ends the survey]

MSG The remainder of these questions pertain to the course that applies to your answer to the previous question.

PQ2. Please enter the Subject and Course Code for the course which applies to your answer to the previous question. ("ABC 123" format. For example, "ENG 101" or "MAT 109")
   ● *[Short-text response]*

PQ3. Which of the following best describes the number of students usually enrolled in a section of this course?
   a) No more than 12.
      [Selecting this option courteously ends the survey]
   b) 12 or more.
   c) 20 or more.
   d) 30 or more.
   e) 40 or more.

PQ4. Would you be interested in allowing this course to be used as a setting for this research to take place?
   a) Yes.
   b) No.
      [Selecting this option courteously ends the survey]

PQ5 Would you be able to commit an estimated 5-10 total hours over 4

Participant Selection Questionnaire

---

months to participate in this study?
   c) Yes.
   d) No.

[Selecting this option courteously ends the survey]

Plus-One Exercise (Tobin & Behling, 2018)

All questions are open text-response.

PQ6. What aspects of your course do your students regularly have questions on consistently every semester?

PQ7. What concepts do students regularly get wrong on assignments, quizzes, or exams consistently every semester?

PQ8. What concepts or topics do your students consistently ask for explanations in a different way than the one you provide?

A Google Form was used to administer the participant selection survey instrument as faculty at the institution are used to receiving surveys in this tool, and it obviated the need to explicitly ask for accurate contact information since the respondents' university email address is collected automatically. A hyperlink to the instrument, along with a brief description of the research was distributed to the faculty via an email list of faculty curated by the setting institution's teaching and learning unit. Both the email message and the instrument clearly communicated that this was not an anonymous instrument. The text of these communications can be found in Appendix B.

Analysis of the participant selection survey responses occurred over three steps. The first was to identify the responding instructors who individually met the following set of criteria for the study: Course Interval and Length; Minimum

Estimated Enrollment; Interest; Time Commitment; and Pedagogical Applicability. Second, the remaining instructors were combined into pairs. These pairings were entirely for logistical purposes aimed at completing the study and are detailed below. The final selection step involved scoring each pair of instructors based on a Participant Pair Viability Rubric (see Table 3.5).

Course Interval and Length (PQ1) accommodates the second research question's experimental comparison and practical limitations of this study. Participating instructors had to have a course which either had two or more sections running simultaneously or consecutively within either the Spring 2021 or Summer 2021 terms. Alternatively, the instructor could have a single-section course which ran during the Spring 2021 term and then again during Summer 2021 as long as both iterations of the course were the same length. In other words, both sections either needed to be fourteen weeks, seven weeks, or four weeks long.

The Minimum Estimated Enrollment (PQ3) criteria attempted to decrease the chances of selecting a participant whose course could be canceled due to low enrollment. Respondents of the participant selection survey were asked to provide an anecdotal estimate of the number of students they typically have in the course they identified that meets the Course Interval and Length criteria. This criterion was also used to spotlight desirable courses with potentially high enrollments; maximizing the potential amount of student data generated.

The Interest (PQ4) criteria goes beyond the logistic criteria for each instructor and their courses. Action research is a partnership where the researcher and subject are both invested in the work being done. In order to prevent the selected instructors from becoming mere "research subjects," respondents were explicitly asked if they would be interested in allowing their course to be a setting for this study. The summary of the study from the initial email was briefly reiterated here. This also had the additional function of letting the respondent out of the survey before needlessly continuing with the more in-depth responses required in the Plus-One section of the instrument.

The Time Commitment (PQ5) criteria specifically asked the respondent if they would be able to commit an estimated 6-15 hours of their time over a four-month period for research activities. This estimated range of time included the introductory engagement, three interviews, and the course modification meeting sessions (Stages 2, 3 and 5), plus any extra independent thought and work pertaining to their course modifications they chose to perform. Similar to PQ4, this question allows the respondent to stop the survey if they select "No," thus avoiding needlessly answering the in-depth Plus-One questions.

The Pedagogical Applicability (PQ6, 7, & 8) criteria was evaluated based on the respondent's answers to the Plus-One portion of the instrument. This seeks to identify instructors who have provided thoughtful answers connected to their students' learning and their course's learning objectives which can be

subsequently examined through the lens of the UDL framework. Responses

pertaining to the administration of the institution, staffing resources, or things

relating to the functioning of technology were considered delimitations for the

study. An example of a desirable response to PQ6 by a chemistry professor might

be "My students have trouble grasping Avogadro's Law." Such a statement

provides a starting point for a pedagogical discussion and reflection with the

instructor about how students in their course learn about Avogadro's Law, which

in turn opens the issue up for inquiry grounded in UDL. Conversely, an

undesirable response to Q6 in the context of this study would be "My students

keep forgetting their account password." While UDL could be applied to this

problem as well, it cannot be directly connected to any course objectives.

　　　　After the respondents who did not meet the above criteria were removed

from the list, the second step of the participant selection process organized the

remaining potential participants into pairs based on the following in order of

priority:

1. Same response for Course Interval & Length (PQ1)

2. Similar Minimum Estimated Enrollment (PQ3)

3. Expanse of UDL Framework Applicability.

The first two criteria are self-explanatory and objective. The third was

more subjective as I needed to predict some likely UDL-based solutions that had

no guarantee of coming to fruition and were based solely on the instructor's own

reflection of the issue in the participant selection survey. Their responses to PQ6, 7 & 8 were synthesized into a single statement which may or may not result in a single, multi-faceted problem to focus on. Essentially, for each Plus-One question response, I asked the following three questions tied to UDL's principles:

1. (Recognition Principle) Could this issue be addressed by providing students with the choice of multiple representations of the applicable content?

2. (Strategic Principle) Could this issue be addressed by giving students the choice to demonstrate their knowledge in multiple forms?

3. (Affective Principle) Could this issue be addressed by providing students with choice in the way they engage with the instructor, course content, and/or their peers?

In general, instructors whose Plus-One responses could be answered with "yes" to as many of the above as possible were paired together to potentially cover as much of the UDL framework as possible.

Finally, each pair of instructors were given a "viability score" according to the rubric shown in Table 3.3 to produce a final list of the pairs ordered by viability score from highest to lowest. The pair with the highest viability score was the first to be asked to participate in the study. It was not necessary, but in the event two or more instructor pairs shared the highest viability score, I planned to arbitrarily number the tied pairs and selected one at random.

Table 3.3

Participant Pair Viability Rubric

Participant Pair Viability Rubric			
Criteria	**3 Points**	**2 Points**	**1 Point**
Course Interval	Simultaneous Spring 2021 Sections	Consecutive Spring & Summer 2021 Sections	Simultaneous Summer 2021 Sections
Minimum Estimated Enrollment	40 or more.	30 or more.	20 or more; 12 or more; or mixed.
UDL Coverage Potential	Potential for all Principles represented.	Potential for two Principles represented.	Potential for one Principle represented.

After identifying an instructor pair to potentially be part of the study, each instructor in the pair was contacted separately in alphabetical order. This communication informed them that they were selected to participate in the study and contained additional details about the methodology, clearly communicating where their time would be required. The text of this communication can be found in Appendix B. In the event one instructor in the pair declined to participate, or had to be eliminated for other unforeseen reasons, the entire pairing and scoring process was repeated to generate new instructor pairs. This happened with the first selected pair, but this refactoring only needed to happen once. Once both instructors in the pair had been secured, their course was assigned a single letter-code ('A' or 'B') which was used to reference their course throughout the rest of the study. The instructors were also assigned pseudonyms. Course A's instructor

was dubbed "David" and Course B's instructor was dubbed "Kelly." These identifiers were used throughout the data collection and analysis process.

Every student who participated in the student survey was given a unique identifier to make specific references to them and also preserve the ability to determine the origin of qualitative statements, while still protecting their anonymity. These unique identifiers were assigned using the following protocol. The first letter of the identifier was 'A' or 'B', depending upon if they were enrolled in Course A or Course B, respectively. The second letter of the identifier referred to the section the student was in. 'C' stood for the control section, and 'T' represented the treatment section. The final two digit number was assigned in no particular order other than the sequence of appearance of their response to the student survey in the collection spreadsheet. For example, a reference to student 'AT05' can be interpreted as "Student five in the treatment section of Course A". 'BC07' refers to "Student number 7 in the control section of Course B."

Stage 2: Onboarding & First Two Instructor Interviews

2a. Introductory Engagement

The purpose of this part of Stage 2 was to introduce the participant instructors to the UDL framework, discuss the specifics of this study, and organize forthcoming research activities. It also served as a pre-interview contact visit (Seidman, 2006). After obtaining the informed consent of the participant instructors, I worked with both to set a time and date to join me individually for a

60–90-minute introductory engagement over the internet using the Zoom video

conferencing software and proceeded through the following agenda topics:

1. Introduction to the UDL Framework and Guidelines.

2. Summary of this study's research methodology.

3. Confirm course intervals and length.

4. Scheduling of First Interviews.

5. Independent Work: Think about Plus-One responses through a UDL

    lens.

I provided the instructors with their responses to the Plus-One portion of

the Participant Selection survey so they may be reviewed prior to the session.

Completing this introductory engagement was a prerequisite in order to

begin the interviews. A follow-up email was sent after each introductory session

with a link to the session recording, and an informed consent form which

complied with the U.S. Office for Human Research Protections' Informed Consent

checklist. Once I had collected signed informed consent agreements, we

scheduled the first interview.

2b. First Instructor Interview

After the first interviews were scheduled and completed consent forms

were received, each participating instructor was interviewed individually. This

study employed Seidman's (2006) in-depth interview series approach for

interviewing participants with some practical modifications for this study. The

first interview in Seidman's interview series pertains to a "dedicated life history."

This study instead narrowed the focus of the first interview to the instructor's

journey from student to educator. The purpose being to gain insight on what

drives each instructors' teaching, gain their perspective, and build rapport with

them for the work we would later perform on their course. Specifically, my intent

was to reveal their transition from a student, to a university professor, and finally

to their current state of teaching online; to connect this lived experience with

UDL; and hopefully help the instructor internalize UDL as they make a connection

between their own challenges as a student and empathizing with their students'

struggles.

All interviews followed a semi-structured format. The first interview was

comprised of the following pre-figured questions:

- Q1: Tell me about your academic background. What was your

  undergraduate & graduate experience like?

- Q2: Tell me about your experience teaching and what led you to be a

  professor.

- Q3: How did you start teaching online?

- Q4: Regarding UDL, what is familiar to you from your previous teaching

  experience?

- Q5: What is new to you in regard to UDL?

I took advantage of frequent follow-up opportunities in an attempt to align their experience to UDL. For example, when the instructor mentioned characteristics of their life as a student, such as being a first-generation college student, I asked how that affected their academic experience. Additionally, if they revealed challenges in their academic work as a result of that characteristic, they were asked what their instructors could have done, or did, to help them to overcome those challenges. Finally, before the end of the first interview I scheduled the second Interview session to occur one to two weeks later.

All interviews with the instructors were conducted using the Zoom video conferencing software (https://zoom.us). They were recorded by default. The resulting digital video recording files were downloaded from Zoom's cloud and stored in the study's dedicated research workspace and then deleted from Zoom's cloud service. The interview recordings each received an initial machine-generated transcript by the Zoom software which was then hand-corrected by the researcher in the institution's video storage and captioning system, Kaltura (https://corp.kaltura.com). All identifying references to real persons and places were manually replaced during the correction process. The final corrected transcript was then stored in a coding sheet implemented using Google Sheets (sheets.google.com). All instructor interview transcripts were kept in a single interview coding workbook, with each transcript receiving its own sheet, or colloquially, "tab". This enabled the sharing of codes across interviews and made

referencing previous interviews simpler.

2c. Second Instructor Interview

The collection protocols for the second instructor interview followed the same collection protocols detailed in the section above. However, the second interview's goals deviated somewhat from what Seidman (2006) outlines. While its focus is still on the present-day, this study also required us to progress in a practical manner to the actual application of UDL in the participant instructors' respective courses. Therefore, it was more open-ended than the first interview as it relied upon the instructor's own responses to the Plus-One exercise to drive the conversation. Each instructor's second interview opened with a brief discussion of the transcript from the first interview to reconnect the instructor with their experience as a student and other previously discussed topics. They were each asked to imagine what it would have been like if they were currently an online student. If the instructor had noted characteristics of their lives as a student which made their academic responsibilities more challenging, I used that as an entry point in discussion of their course and applying UDL to it. The questions below were used as guides and tuned accordingly to the individual instructor's personal experience.

- Q1: Thinking about our discussion from the last interview, I would like you to think back to what your life was like as an undergraduate/graduate student and then imagine that experience

is taking place today and all of your courses are online. Given the life factors you experienced at that time are still in place, what would your experience be like?

- Q2: Now, thinking about your responses to the initial participation survey, Tell me more about what drove you to enter those responses (this may need to be several questions depending on the depth of the instructor's responses to the Plus-One exercise.)

- Q3: Do you see any connection between UDL, your own experience as a student, and your observations of your students?

- Q4: How might adding multiple means of representation to ____ help address this/these issue(s)?

- Q5: How might adding multiple means of action and expression to ____ help address this/these issue(s)?

- Q6: How might adding multiple means of engagement to ____ help address this/these issue(s)?

Next, I attempted to guide the conversation by suggesting a specific part of the course as a potential target for UDL modification. This was a means to continue dialogue, though. I tried not to interfere in the instructor's thought process, and ultimately, the modifications selected were their choices. To manage the scope of the modifications, I limited the instructors to a specific unit, assignment, or aspect of the course. This was both practical for the timeline of

this study, but also the essence of Behling and Tobin's "Plus One" method. It encourages iteratively focusing on a single aspect of a course and improving it.

By the end of the second interview, I had rough and informal plans for what our focus would be to modify in the course. With that, the study could proceed with other, non-interview related stages. The third interviews happened much later after the modification planning and implementation had occurred and student data were collected. The next immediate task was to prepare a written proposal outlining the modifications to be made, who was responsible for the requisite work. Additional collaborative work sessions were scheduled after the second interview to this end.

Stage 3: Course Modification

3a. Developing the Course Modification Proposals (CMP)

In order to ensure myself and participant instructors had a shared understanding of how their respective treatment sections would be modified, I produced a Course Modification Proposal (CMP) for each of them that documented in writing what was discussed during the second interview and subsequent work sessions. Prior to this, though, I found it necessary to schedule an additional "brainstorming session" after the second interview to provide them with some more fleshed out "pitches" for the area of the course we should focus on. The detailed account of these meetings for each course are documented in Chapter 4.

I prepared a draft of each instructors' CMP once each instructor settled on an area of focus for their course. The purpose of the CMP was for record-keeping to minimize the chances of a miscommunication with the instructor and to maintain trustworthiness. In addition to a table detailing the UDL modifications, each CMP document contained a set of fields explicitly stating which of the instructors' sections would be used as the control and which would be the treatment. It also summarized the scope of the modification work and detailed the logistics for how students in the course accessed the student survey. Additionally, the proposal included a code of ethics which guided my practice when assisting the instructor in selecting and implementing the modifications. The text of the code of ethics was as follows:

1. No Surprises: I'll vet any new/changed materials with you before they go into the course.

2. Sustainable Improvement: I won't implement things you cannot update on your own in order to continue their use after the study is done. I'll provide training for anything you don't understand. You'll have full access to materials created for the treatment section in perpetuity. Once the study is complete, they belong to you.

3. Time Conscious: Wherever possible, I will do any production work. Most of your time investment will go toward vetting my work, or answering any content-related questions I have, unless a modification specifically involves

the nature of your engagement with your students.

4. No Burden on Students: We will only use tools they already have institutional access to. Nothing will impose additional technical or financial requirements upon them.

The table detailing the modifications to the treatment course contained columns with the following information: Modification Description, Aligned Course Objective, UDL Principle Alignment, Action Steps by Learning Designer (myself), Action Steps by Instructor, and Measurement. The last "Measurement" field listed data tied to that specific modification that would be collected. In order to keep the scope and work involved in modifying the courses under control, modifications were limited to between three and five, and were focused on a particular unit or assignment in the course. After a draft CMP had been completed for a course, I scheduled a work session with the corresponding instructor through Zoom. In those sessions, I walked each instructor through their proposal draft, fine-tuned it, and made corrections. Once the instructor was satisfied with the work to be done, they were asked to make verbal confirmation that they understood the proposal, which was documented via the work session recording. Table 3.4 below provides a demonstration of what a completed CMP looks like using fictional information. Complete details on Course A and B's respective CMP documents are detailed in Chapter 4.

Table 3.4

Example Course Modification Proposal (CMP)

Example Course Modification Proposal (CMP)				
Course: ABC 123	**Scope of Work:**	The course's final paper will be changed to a "final project" modified as detailed below.		
Control Section: 0001	**Aligned Course Objective**	Demonstrate the ability to apply Sprocket Theory to your life.		
Treatment Section: 0002				
Modification	**UDL Alignment**	**LD Action Steps**	**Instructor Action Steps**	**Measurement**
Interactive assignment instructions with hyperlinked mentions of course concepts.	Recognition	Gather external resources, add them to the course, and hyperlink relevant parts of the instructions.	Modify existing instructions to match the new vision. Review LD's work to ensure that it matches the goals of the course.	Use the View Reports tool to measure clicks on the links.
Allow students to submit a paper, presentation, video, podcast, or other format proposed by the student.	Strategic	Assemble tech guides and examples to include in assignment instructions.	Same as above	Count the number of different ways students complete the assignment and the frequency of each type..

Example Course Modification Proposal (CMP)

Course:	ABC 123	Scope of Work:	The course's final paper will be changed to a "final project" modified as detailed below.
Control Section:	0001	Aligned Course Objective	Demonstrate the ability to apply Sprocket Theory to your life.
Treatment Section:	0002		

Modification	UDL Alignment	LD Action Steps	Instructor Action Steps	Measurement
Develop and communicate a format-neutral grading rubric for the project	Affective	Assist instructor in identifying criteria and defining quality levels, as well as configuring the rubric in the LMS.	Decide the course content-relevant criteria by which to grade students.	Add questions to the Course Content survey measuring the usefulness of this.

Student Survey Logistics

Announcement & Availability Date	Link Location	Survey Link
April 25th, 2021	In the Instructor's weekly announcement and in the Module for Week 7	[URL to survey]

Data Collection Date:	May 15th, 2021

The completed CMPs were stored in the study's dedicated research workspace and their respective instructors provided access to them for reference via a link contained in an email. Once a course's CMP document was complete and acceptable to the instructor and myself, work on implementing those modifications in the treatment section commenced.

3b. Implementation of Course Modifications

The instructors and I implemented the modifications in their respective treatment course sections. Links and instructions for the student survey were also added to all sections, but were hidden until the dates decided upon in the CMP document. Intermediary work sessions were scheduled, particularly when a modification required the instructor to learn a new skill, which will be recorded and noted in the research log.

When the modification action steps were completed for a course, I sent an email to the corresponding instructor to schedule a final work session. During that session, we walked through the modifications together to ensure that the work matches both of our expectations. Each instructor verbally confirmed their approval of the work in their respective final work sessions. We also established dates to collect data from the course sections. Finally, I made myself available should the instructors and their students encounter technical challenges in relation to the course modifications as the students proceed through the modified content. The specific details of the implementation of each course's modifications

can be found in Chapter 4.

Stage 4: Student Data Collection

4a. Student Survey Instrument & Collection

   The student survey instrument voluntarily and anonymously collected data

from students in the control and treatment sections of each course involved in

the study. The questionnaire was divided into several parts as detailed in Table

3.6 below. It included a student background portion containing demographic

questions about their age range, the gender identity, disability status, whether or

not the student has reported their disability(ies) to the university, race/ethnicity,

English-language status, and current GPA. The data collected from this section

regarding students' demographic characteristics was used to address the fact that

this is a quasi-experimental study that cannot guarantee identical control and

treatment section student groups. It allowed me to disclose how different the

treatment and control sections of each course are.

   The second part of the questionnaire involved students' attitude and

experience with the course modifications. These questions were created prior to

participant selection and designed to be tailored toward the specific aspect of the

course that was modified. Table 3.5 offers the original, pre-modification set of

questions that were later customized for each course. The bracketed text is the

portion of each question that was customized for the course that it was used in.

The specific questions used for each course can be found in Chapter 4.

The six questions in the second part are paired in a structure that aligns with the three-network model that the UDL framework is built upon. For each pair, the first question provides a quantitative likert rating of the modifications' effectiveness for addressing the behaviors governed by that associated network. The second question is open-response and asks the student to elaborate on the rating they gave in the previous question. The 'affect' pair asks students the degree to which the part of the course targeted for modification made them feel motivated, and what aspects of the modification target elicited that feeling. The 'recognition' pair asks students the degree to which the modification target made them feel knowledgeable and what aspects of the target made them feel that way. Finally, the 'strategic' pair asks the students the degree to which the target of the modifications gave them a sense of what they needed to do and then to describe the process they employed to reach an endpoint.

The third section's focus is on social validity, the context of the course (Wolf, 1978). It asks a short series of questions outside the conceptual framework of the study to gain an overall sense of the acceptability of this research to those who have participated in it. The instructors also answered a number of social validity-aligned questions as part of the third interview. Next, a single likert and open-response question pair asks students to communicate their perception of their learning needs being met in the course. In other words, it asks if they felt the modified aspect of the course was fair to them. The final section of the

questionnaire contains a single open-response question. While not apparent at

first, this question is very deliberate in its inclusion. I am concerned that my

privilege and perspective as an academic professional will lead to an instrument

which will not be interpreted by students in the way I anticipated. This question

also represents a final opportunity to gather qualitative data that are relevant to

the second research question and perhaps reveal insight this design does not

consider.

Table 3.5

Student Survey Questionnaire

Student Survey Questionnaire
Unless otherwise stated, Likert response questions are scaled as follows: 1) Strongly Disagree, 2) Disagree, 3) Undecided, 4) Agree, 5) Strongly Agree.
Student Background Questions

Q1.   Please indicate your age:
      a) 18 - 24
      b) 25 - 31
      c) 32 - 38
      d) 39 - 45
      e) 46 - 52
      f) 53 - 59
      g) 60 - 66
      h) 67 or older
 	
Q2.   How would you describe your race and/or ethnicity?
      a) Asian or Pacific Islander
      b) Black or African American
      c) Hispanic or Latino
      d) Native American or Alaskan Native
      e) White or Caucasian
      f) Multiracial or Biracial
      g) I would prefer not to answer.

Student Survey Questionnaire

Q3. How would you describe your gender?
   a) Female
   b) Male
   c) Transgender/Gender non-conforming/Non-binary
   d) Other
   e) I would prefer not to answer.

Q4. How would you describe your level of physical and cognitive ability?
   a) I have a disability.
   b) I have a physical disability.
   c) I have a cognitive disability.
   d) I have physical and cognitive disabilities.
   e) I do not have a disability.

Q5 Which of the following describes you:
   a) I have reported my disability(ies) to the university Disability Services Office.
   b) I have not reported my disability(ies) to the university Disability Services Office.
   c) I do not have a disability

Q6. Is English your first language?
   a) Yes
   b) No

Q7 How would you describe your employment status?
   a) I am not employed.
   b) I am employed part-time.
   c) I am employed full-time.

Q8. How would you describe your enrollment status with the university?
   a) Part-time
   b) Full-time

Q9. Which range does your current GPA fall into?
   a) Less than 2.0
   b) 2.0 - 2.49
   c) 2.5 - 2.99
   d) 3.0 - 3.49
   e) 3.5 - 4.0

UDL-Aligned Modification Questions (a = Likert, b = Open Response)

Q10a. **(Affective)** Compared to the rest of the course, [this assignment] made me feel more motivated to work on it.

Student Survey Questionnaire

Q10b.	What aspects of [this assignment] and the supporting materials helped, or didn't help your motivation?
Q11a.	**(Recognition)** Compared to the rest of the course, [this assignment] made me feel knowledgeable about the topic.
Q11b	What aspects of [this assignment] and the supporting materials did or didn't help your understanding?
Q12a.	**(Strategic)** Compared to the rest of the course, [this assignment] gave me a clear sense of what to do and how to go about it.
Q12b	Describe your process for completing [this assignment]. In other words, what strategies did you employ, resources you used, etc.

Social Validity Question Set (Likert-Scale)

Q13.	I liked [this assignment].
Q14.	[This assignment] allowed me to demonstrate my understanding of [course concept or objective].
Q15.	[This assignment] measured my understanding of [course concept or objective] appropriately.

Perceived Learning Needs Questions (a = Likert, b = Open Response)

Q16a	I felt that [this assignment] was set up in a way that was fair and met my personal learning needs.
Q16b	What aspects of [this assignment] made you feel this way?

Optional Open Feedback (Open Response)

Q17	Do you have any other feedback regarding [this assignment] you wish to share?

Each course had its own copy of the survey and a corresponding spreadsheet to collect raw responses. Each spreadsheet was labeled according to the course's letter-code ('A' or 'B') followed by either "control" or "treatment." Once the data collection date arrived, I collected the qualitative and quantitative data from the Student Survey and other sources outlined in the course's CMP. While the survey did not collect any identifying information from students, the

open responses had identifying information, such as names, email addresses, etc,

removed. This includes mentions of the setting institution and academic

programs. Once any identifying information was removed, the open response

content for each students' response was copied, labeled by course and section,

and consolidated into a Google Sheet titled "student data qualitative coding

workbook." Each open response from a question by a student occupied a single

row in the sheet. Each row in this workbook had a large number of categorical

fields, and the selection of them was an emergent part of the analysis process.

Defining them all here would lack context and be confusing, therefore all of the

field definitions for each column in the Student Data Qualitative Coding

Workbook and the rationale for their existence are defined later in the *Stage 6:*

Data Analysis section.

4b. Quantitative & Other Student Data Sources

There were three viable sources of quantitative data collected in this study:

1. Modification-relevant assignment scores from the institution's
   Learning Management System (LMS) grading tool.

2. Modification relevant activity and document access statistics.

3. Data collected from quantitative-oriented questions in the student
   survey.

All of these collection activities excluded identifying personal information.

In the few instances where exported data from the LMS contained personally

identifiable information, it was expunged from the local computer prior to being

stored in the study's dedicated research workspace.

The quantitative data from each sections' survey were consolidated into a

single quantitative analysis spreadsheet with three additional columns for the

numeric row from the original collection sheet, instructors' letter-code, and

whether the data were from a control or treatment section. Finally, this combined

quantitative data sheet was exported to a comma-delimited text file so that it may

be imported into statistical analysis software.

4c. Preliminary Data Analysis

The only purpose of this action was to have a basic, un-analyzed set of

student data to present to the instructor to scan through and be used as a focus

for discussion during the third interview. Once collection was complete for the

student data of an instructors' course, the instructor was contacted to schedule

the third interview. They were provided with raw, uncoded qualitative data,

descriptive statistics for the quantitative data, and copies of the transcripts of the

previous two interviews and asked to review them prior to the interview. I

encouraged them to inform me of any inaccuracies in my correction of their

interview transcripts and to make sure they communicated their initial verbal

intent.

Stage 5: Third Interview

The third interview in Seidman's (2006) interview series centers upon reflection. In this interview, the participant instructors were asked to reflect on the semester, their observations of their students as they worked through the modified portion of the course, and the student data I collected. We explored their perceptions of UDL and the nature of any change in those perceptions. In addition, the instructors were asked questions pertaining to social validity and their perspective of the acceptability of the modifications and the process that led to them (Q6 - Q9). The questions below were starting points to provide opportunities for deeper follow-up exploration.

- Q1: Tell me how things went for you and your students in your course sections. Did you notice anything different about your students between the two sections?

- Q2: Let's discuss the data from your course sections [brief summary]. What do you think of what your students said?

- Q3: Thinking back to when we started this project, how have you changed as an educator?

- Q4: What do you wish we had done differently?

- Q5: What are your aspirations for this course and others?

- Q6: Overall, how did you like this process?

- Q7: Do you think you solved the problems you disclosed at the beginning

of this process?

- Q8: How worthwhile was this process in terms of benefit to your students?

- Q9: How worthwhile was this process to you as an educator?

- Q10: How likely are you to apply UDL thinking into your teaching in the future?

- Q11: How likely are you to recommend or advocate UDL thinking to your colleagues?

As with the previous two instructor interviews, this one was semi-structured and followed the same collection protocol outlined in the section detailing the first instructor interview on page 74. Once collection and transcript correction were complete for the third interview, full analysis of the interviews and other collected data could commence as outlined in the following sections.

Stage 6: Data Analysis

6a. Instructor Interview Analysis Protocol

Instructors are humans and learners, too. Therefore, the same three-network brain model that serves as the foundation of UDL can be used to analyze their interview responses in a similar manner to the method used for the student qualitative data. The deductive coding pass highlighted instructor statements which applied to an emotion, and area of content knowledge related to their practice as an education, or exposition of a strategy they previously, currently, or aspired to use. These statements were described through the "Locus" category,

which situates the statement within the continuum of the instructors' experience. Visual inspection, review of notes, and basic descriptive statistics were used to create a profile of the instructors' experience throughout the process which includes aggregated themes, evidence of changes in affect toward their course, students, online teaching, UDL, etc. This study's first research question was used to focus this discussion; "How does guided engagement of UDL change instructors' perception of their students, course, and practice as an educator?"

The coding sheet methodology used for the interview analysis was inspired by traditional qualitative analysis practices (Ralis & Rossman, 2017). Prior to the first pass of coding, the recording was watched and the machine-generated transcript manually corrected. The recordings were kept readily available for reference in case they were needed to capture information that may have been lost in the transcript. The first pass over an interview transcript involved splitting and combining David or Kelly's statements into logical, chronological excerpts; each occupying a row of their transcript sheet. The logic for this was based on the subject the instructor was discussing, however in cases where the excerpt became too large, I would split it to make it more manageable. If the instructor said something that struck me as particularly important, it would be split into its own excerpt row. In the cell next to each excerpt, I added my own summary, interpretation and notes pertaining to that moment in the interview. The next pass over the transcripts focused on coding each excerpt using UDL-aligned,

predetermined categories (Efron & Ravid, 2019) defined in Table 3.6 and applying

as many inductive "aspect" codes as necessary to give the coding for that excerpt

more context. An example of a coded interview excerpt is provided in Table 3.7.

Table 3.6

Instructor Qualitative Data Coding Scheme

UDL Alignment	Locus	Aspect(s)
Affective	• Instructor's experience as a Student • Past Practice • Present Practice • Aspirational	Expression of emotion in relation to their course, students, colleagues, and themselves.
Recognition	• Instructor's experience as a Student • Past Practice • Present Practice • Aspirational	Connections to the practice of teaching, skills, correct application of UDL, understanding of their own field or course-specific content.
Strategic	• Instructor's experience as a Student • Past Practice • Present Practice • Aspirational	Employment of a strategy. Could be the same as the metacognitive strategies used by students, but likely will be a different or overlapping set.

Table 3.7

Instructor Qualitative Data Coding Example

Example Excerpt	Notes	UDL Alignment	Locus	Aspect 1	Aspect 2
I would say that they always reflected back on examples for practice. Or how this it could be utilized for future leadership and in nursing. Certainly at a graduate level. We often presented the concepts and the faculty, as a leader, would guide us to new questions so that we could discover our own journey.	Kelly's mentors encouraged reflection on past examples and practice. They also guided their students to new avenues for inquiry.	Strategic	Instructor's experience as a Student	Reflecting on Mentors	Reflection as a useful skill

6b. Student Data Analysis Protocol

Qualitative analysis of the student data demanded an unexpected amount of effort in order for meaningful interpretation. Early attempts to code these data made it apparent that the original methodology I planned to use would not be sufficient. The predetermined categories needed to be modified or expanded to allow for emergent categories (Efron & Ravid, 2019). I was attempting to align student statements to UDL's framework without any specific classification for different outcomes students described. Students' statements also often had multiple phrases which could be attributed to multiple UDL networks. The first three passes over the data consisted of a significant amount of second-guessing, frustration, and a persistent feeling that "something is wrong."

After several weeks of this, I decided to let go of the study's original coding schema and look at the structure of students' statements without trying to impose the UDL framework upon them. Four patterns quickly revealed themselves:

1. Students frequently mentioned some element of the course or the modified assignment followed by some sentiment (henceforth referred to as an "outcome") attached to it.

2. Students often included multiple sets of these course element-sentiment pairs in a single response, one element attached to multiple sentiments, or vice-versa.

3. Students often wrote valid feedback that did not actually answer the question.

4. Students repeated themselves, mentioning the same element and sentiment multiple times across several open response questions. Essentially, student's statements were often too nuanced for my original coding protocol.

These four observations were crucial to the revision of the study's coding protocol. The revised protocol, shown below in Table 3.8, addressed those observations and made it possible to code the data with more validity.

Table 3.8

UDL-Aligned Qualitative Coding Protocol

Step	Action
1	**Split responses into statements for each course element or outcome mentioned.** Examine the response and look for the element-outcome pair. If there are multiple pairs, an element with multiple outcomes, or multiple elements with the same outcome, split the response into multiple rows in the coding sheet for however many multiple elements or outcomes were in the original.
2	**Identify the course element** the student is referring to in the statement. Select an existing, or add a new code for the "Course Element" category as appropriate.
3	**Identify the outcome detail** the student is referring to in the statement. Select an existing, or add a new code for the "Outcome Detail" category as appropriate.
4	**Exclude students' repeat element-outcome pairs.** Look at all statements from a student and exclude rows from the dataset that have a statement expressing an element-effect pair that student has already expressed.
5	**Consolidate Codes.** Examine the Course Element and Outcome Detail categories for codes that are similar.

Step	Action
6	**Determine UDL Alignment of Elements and Outcomes.** Use the UDL Coding Rubric to assign a UDL alignment any new codes in the Course Element and Outcome Detail categories.
7	**Assign codes to other Secondary Categories** based on the codes from the four primary categories.

One "pass" over the qualitative student data consists of these steps

The third observation was particularly damaging to the original scheme. The student survey's open response questions aligned particular course elements with the UDL framework. That was to form the foundation from which I built my analysis. However, I was operating under the false assumptions that students would enter their statements in the correct fields, not misinterpret the question, and not simply enter whatever was most on their mind at the particular moment they were filling out the survey. This isn't to say that the UDL alignment of the survey questions was a fruitless effort. They did help focus many students toward the aspects of the course modifications, but I would have had to throw out too much otherwise usable data if the original protocol had been followed. Therefore, the revised protocol only considers which question the student is answering when they were too vague about what element of the modified assignment they are referring to in coding the Course Element field of the statement's row in the coding sheet. For example, consider the statement, "I liked the discussions." "Discussions" in this case is the course element mentioned, however it is not specific enough to attribute it to a more specific element pertaining to the

discussions. If the statement appears in response to the Affective-aligned survey question, I would code that statement with one of the more specific, Affective-aligned course elements. In this case, "Topic Value & Authenticity" seems the most appropriate.

The UDL-Aligned Qualitative Analysis Model.

Codifying this relationship between course elements and student outcomes also cleared the way for a more specific schema to dictate the UDL alignment of course elements and student outcomes found in their responses. Prior to additional attempts to code the student data again, I spent time reviewing CAST's online UDL resources, and Meyer & Rose's 2002 and 2014 texts on UDL. I also performed a very informal qualitative analysis of the text of the UDL guidelines themselves; identifying course elements and under which principle they appeared. Thanks to these efforts, I realized that there is a subtle, but crucial difference between the core conceptual model underpinning the UDL framework, and the UDL principles. All of the UDL principles and their subsequent guidelines and checkpoints are worded as prescriptive directives for instructors to perform. For example, the Affective-aligned, Engagement principle states, "Provide multiple means of Engagement." Guideline 3, which is part of the Recognition-aligned Representation principle states "Provide Options for Comprehension." Checkpoint 4.2 of the Physical Action guideline, under the Strategic-aligned Action and Expression principle states, "Optimize access to tools and assistive technologies."

All of these statements are written with the intent of providing those who are teaching with direction. The core UDL framework, however, is neutral. It simply provides a model which describes the broad strokes of what we know about how the human brain learns and the roles the various parts of the brain fall into in the learning process. It consolidates the brain "networks" defined in the field of neuroscience into three sets. As established in Chapter 2, The Recognition networks govern our perception and understanding of stimuli acquired through our senses. The Strategic networks govern how we plan and execute various tasks. Finally, the Affective networks govern our purpose and motivation when learning. With this distinction in mind, the UDL principles with their guidelines can be thought of as an "application" or "implementation" of the core UDL framework. That implementation's purpose is to describe a set of actions which incorporate learner variability that can be performed by an instructor to maximize students' learning potential. Therefore, it should be possible to apply the core UDL framework for other purposes as well, such as the categorization of various course elements, or outcomes expressed by students, allowing us to systematically describe their relationships to each other. Tables 3.9 & 3.10 show the rubrics I developed to identify codes for Course Elements and Student Outcome categories for the revised protocol.

Table 3.9

Course Element UDL Alignment Rubric

Course Element UDL Alignment Rubric	
Code	**Associated Features**
Recognition	• Course materials used to present course concepts • Attributes of discrete course materials, such as formats, fonts, text size, caption accuracy, language, etc.
Strategic	• The organization and consistency of the overall course and its materials. • Supports to help students use technology tools to express their knowledge. • The implementation of the course's assessments, such as the way assessments are scaffolded or paced. • The methods allowed for students to demonstrate their knowledge and skill of course concepts. • Pedagogical support materials communicating the instructor's expectations for the course's assessments such as the course syllabus, assignment instructions, rubrics, exemplars, etc.
Affective	• Efforts by the instructor to draw and maintain students' interest throughout the course. • Efforts by the instructor to activate students' sense of personal relevance, authenticity, and value in regard to course concepts. Particularly in regard to career relevance. • Efforts by the instructor to increase their own presence in the course. • Efforts by the instructor to mitigate aspects that cause stress and anxiety and availability of coping strategies for aspects that can't be mitigated. • Opportunities for student choices in the learning process. • Feedback on assessments that focuses on growth. • Peer-collaboration and community. • Use of reflection in the course.
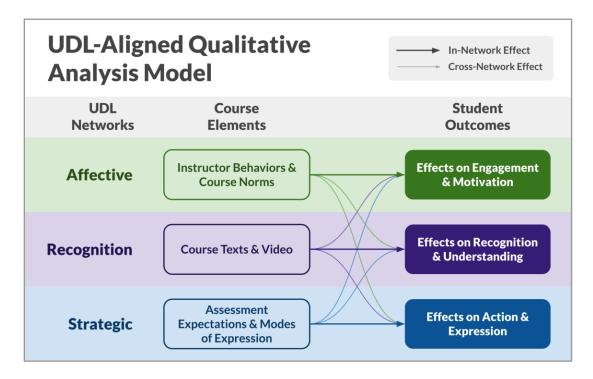
Table 3.10

Student Outcome UDL Alignment Rubric

Student Outcome UDL Alignment Rubric	
Code	**Associated Features**
Recognition	Perceptions of a course element's fidelity, organization, utility, or effectiveness at helping them understand course concepts.
Strategic	Expression of all or part of their process for executing an assessment, and/or perception of a course element's effectiveness at easing usage of technology tools, navigating the course, or helping them understand the instructor's expectations for an assignment, enabling them to express their knowledge in a preferred way.
Affective	Perception of a course element's effectiveness at engaging and motivating them; affecting their confidence; modulation of emotion, reflection on work; Self-stated progression, growth; projection of themselves in the future.

Armed with the understanding that student statements could be synthesized into pairs of course element-student outcome relationships and with explicit implementations of UDL as applied to course elements and student outcomes, I established the UDL-Aligned Qualitative Analysis Model shown in Figure 3.2. This diagram visualizes the interconnectivity between elements and outcomes. Essentially, it says a course element of a particular alignment to one of UDL's networks can influence student outcomes in either the same (in-network) or different (cross-network) UDL network.

Figure 3.2

UDL-Aligned Qualitative Analysis Model (UDL-QAM)

In addition to the four primary code categories of Course Element, Element UDL Alignment, Student Outcome, and Outcome UDL Alignment, I developed several additional secondary categories in an attempt to make more general codes that would be applicable across courses, regardless of field, and also to group outcomes by very general rules for the purposes of summarizing a large number of codes. Table 3.11 provides a complete list of the code categories and their definitions used in the analysis of the qualitative data from the student survey. Each row in the analysis sheet had a column assigned to one of these categories

Table 3.11

Qualitative Student Data Code Categories

Code Category	Definition	Possible Codes
Filtering Categories		
Course	The course this statement originated from.	'A' or 'B'
Section	The section of the course this statement originated from.	'Control' or 'Treatment'
Student	Anonymized identifier for the student this statement originated from.	Student's anonymous identifier
Question	The question on the student survey this statement originated from	Survey question #
Likert	The score the student gave for the Likert question paired with this open response question. Used to inform students' intent when they provide a vague statement.	Single digit 1 through 6
Primary Analysis Categories		
Course Element	The course element mentioned by the student in their statement.	Inductive. See Chapter 4 for a list of codes.
UDL Course Element Alignment	The UDL alignment of this statement's Course Element code as determined by the Course Element UDL Alignment Rubric in Table 3.7	Affective, Strategic, or Recognition
Student Outcome	The feeling, experience, opinion, result, etc. the student attributes to the Course Element code for	Inductive. See Chapter 4 for a list of codes.

Code Category	Definition	Possible Codes
	this statement.	
UDL Student Outcome Alignment	The UDL alignment of this statement's Student Outcome code as determined by the Student Outcome UDL Alignment Rubric in Table 3.8	Affective, Strategic, or Recognition
Secondary Analysis Categories		
Modification	The modification most likely to have contributed to this statement. Applied hypothetically to statements originating from control sections. An attempt to determine the impact of specific course modifications. Set to 'Unmodified' if student referred to an element that was not modified in this study.	Unmodified, or the ID of a modification made in the course (see Chapter 4)
Element Group	A broad set of course elements this statement's Course Element falls into. Makes it possible to generalize between courses in different fields.	• Assessment Expectations • Course Texts & Videos • Execution • Instructor Availability & Feedback • Modes of Expression • Pacing & Scaffolding • Peer Interaction • Relevance, Value & Authenticity • Scholarly Research • Student Choice • Technology Tools
Effect	A UDL-aligned generalization of the Student Outcome code that enables differentiation between outcomes that negative or non-	• Affective • Negative Affective • Recognition • Negative Recognition

Code Category	Definition	Possible Codes
	negative (positive or neutral)	● Strategic ● Negative Strategic

Appendix C contains a complete map of all codes identified in this study

and the hierarchical relationships between categories. The Filtering Categories

listed in Table 3.9 are present for recordkeeping purposes and to make it easier to

filter the statements displayed in the analysis sheet to those from a specific

course, section, student, etc. The purpose of most of the Secondary categories is

to aid in broader generalization of the data. Where the Course Element category

allows us to see how specific course elements affected students, it does not tell

us specifically what impact the course modifications in the treatment section

might have had. The Modification category offers an alternative method of

organizing and comparing the data that specifically identify statements which

might have been influenced by a modification. In the case of statements which

originated in a control section, I made the selection of this code if the student

mentioned an element that was modified in the treatment section. The caveat to

this category is that I believe code selection to be very subject to my own

interpretation and bias, which is why Chapter 4 presents the qualitative results

through both the lenses of the Course Element category and the Modification

category. The Element Group secondary category is a set of course element

groupings designed to be field agnostic. This allows data from multiple, different

courses to be analyzed together. Finally, The Effect secondary category distills the

myriad of Student Outcome codes generated by this study to a small set of more

general UDL-aligned codes. It is meant to be used to summarize results and mark

statements which express a negative outcome by students.

While the majority of the Course Element and Student Outcome codes emerged inductively as the result of successive passes over the data, there are a few exceptions. The "Execution" course element code was created early on to denote a student statement that exposed part or all of the student's metacognitive process for completing the modified course assignment. A set of Student Outcome codes meant to be used primarily as partners with the Execution code were also created early on and were based on my own UDL-aligned groupings of the metacognitive strategies defined by Hattie (2009), Lavery (2008), and McGuire (2015). Table 3.12 lists them below. As the coding process went on, however, other instances arose where it was appropriate to pair these codes with other course elements.

Table 3.12

Outcome codes paired with the 'Execution' Course Element code

UDL Alignment	Metacognitive Strategy Outcome Code
Strategic	- Reviewing, Self-Monitoring, Task Strategies & Goal Setting - Organizing Information Into Knowledge & Env. Restructuring - Self-Instruction, Rehearsing/Memorizing & Imagery - Help Seeking & Time Management
Affective	Self-Evaluation & Self-Consequences (Reflection)

Once the data were coded, numerous pivot tables were generated to examine the data and compare the percentage-based prevalence of various

element-outcome pairs. To add a visual component to the analysis, Google's

Charts API (https://developers.google.com/chart) was used to create alluvial

diagrams to visualize the data. The beginning of Chapter 4 contains a guide on

how to read these charts.

Student Data Coding Example.

To make the coding protocol clear, this section provides a detailed example

that applies the protocol to an actual student response from the data, and walks

you through my thought process as I fully code the student response. This

example uses an actual response to the following student survey question: "Q10b:

What aspects of the teaching video project and its supporting materials helped, or

didn't help your motivation to work on it?" This was the Affective-aligned open-

response question on the survey. The response comes from student BT09

(Course B, treatment section, student number 09):

The fact that it was broken down over multiple weeks really

helped me think more extensively about the material at hand. I also

appreciate our choice of topic and our professor's comprehensive and

timely feedback contributed immensely to my motivation to improve

and complete.
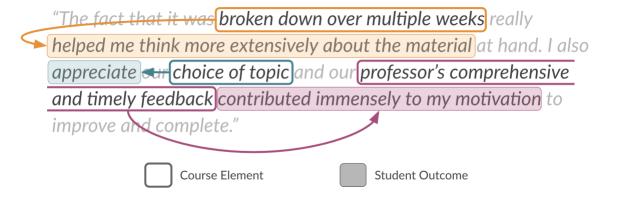
The first step is to break the response down into separate statements

according to the pairs of course elements and student outcomes mentioned in the

response. I found that the best way to begin was to look for references to course

elements, which would dictate how many statements the original would need to be divided into. This example response mentions three course elements. The phrase, "broken down over multiple weeks," is a reference to the pacing and scaffolding element of the project. Second, the student mentions "choice of topic." Finally, the student also mentions the "professor's comprehensive and timely feedback."

Before this response can be split up into discrete codable statements, the outcomes connected to their respective course elements must be identified. "Think more extensively about the material," is the outcome of the "broken down over multiple weeks," course element. "Appreciate" is the outcome of "choice of topic". Finally, "contributed immensely to my motivation" is the outcome of, "professor's comprehensive and timely feedback." Figure 3.3 below illustrates these pairings.

Figure 3.3

Course Element and Student Outcome Pairs

"The fact that it was broken down over multiple weeks really helped me think more extensively about the material at hand. I also appreciate our choice of topic and our professor's comprehensive and timely feedback contributed immensely to my motivation to improve and complete."

☐ Course Element   ▨ Student Outcome

With the element-outcome pairs identified, I can now split the response up into three separate statements in the analysis spreadsheet, as illustrated below in Table 3.11. After selecting the Course Element and Student Outcome codes, I use the rubrics in Table 3.9 and Table 3.10 to identify the UDL alignment of the element and outcome. Finally, I select the appropriate codes for the secondary categories as previously defined above in Table 3.11. Below, Table 3.13 shows the fully coded response. Please note, in order to accommodate this document's page size, Table 3.13 excludes the filtering categories and the data are presented transposed, otherwise it would be too wide. In the actual analysis spreadsheet, the rows are columns and vice-versa.

Table 3.13

Fully Coded Example

Category	Statement 1	Statement 2	Statement 3
Statement	The fact that it was broken down over multiple weeks really helped me think more extensively about the material at hand.	I also appreciate our choice of topic	and our professor's comprehensive and timely feedback contributed immensely to my motivation to improve and complete.
Course Element	Pacing and Scaffolding	Choice of Topic	Instructor Availability & Feedback
Element UDL Alignment	Strategic	Affective	Affective
Student Outcome	Helped Understand Topic or Concept	Helped Engagement & Motivation	Helped Engagement & Motivation
Outcome UDL Alignment	Recognition	Affective	Affective
Modification	B2 (Pacing & Scaffolding - Strategic)	Unmodified - Affective	Unmodified - Affective
Element Group	Pacing and Scaffolding	Student Choice	Instructor Availability & Feedback
Effect	Recognition Statement	Affective Statement	Affective Statement

Note: This example is presented transposed to accommodate the page size. In the actual analysis sheet, the rows are columns and vice-versa.

Quantitative Analysis.

The JASP (https://jasp-stats.org) software package was used to perform quantitative analysis. JASP is an open-source alternative to SPSS built around the highly-regarded and extensively-used "R" statistics programming language. Because small sample sizes and non-normally distributed data were anticipated for the quantitative portions of this study, the Mann-Whitney U test was selected to test survey and other results for statistical significance. The UDL Aligned question set (Q6, 7 & 8), the social validity questions (Q9, 10, &11), and the Perceived Learning Needs question (Q12) underwent statistical analysis. Only descriptive statistics were calculated for the demographic question set (Q1 - Q9) for the sake of providing a demographic description of each course section. Tables containing these data are included in Chapter 4 in order to avoid obfuscating the fact that this study cannot guarantee true control and experimental student groups that are representative samples of the student population.

All statistical comparisons used the Mann-Whitney U test due to the ordinal, non-parametric nature of the dependent variables analyzed. Effect sizes are reported in rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."

Student Experience Analysis

The qualitative student analyses from each course was reviewed and considered together as a whole, looking for additional interesting patterns, and correcting any errors in coding from previous passes. Themes for the control and treatment sections were compared with each other to generate a cross-section qualitative comparison. The second research question, "How does the addition of UDL-driven course modifications affect student outcomes within an online course?" served as an overarching guide to this analysis, but was refined into several more precise sub-questions to better structure the resulting analysis:

- How do the treatment and control section qualitative findings differ from each other?

- What evidence is there that the course modifications had an effect on students' affective, recognition, and strategic networks?

- What other factors could explain what is being expressed in the data?

Next, the results of the quantitative data analysis were considered together with the conclusions derived from the qualitative analyses above. Several more sub-questions of research question two were created to guide this comparison:

- How do the qualitative and quantitative student data complement or contradict each other?

- What factors might explain disparities between the two?

- How could this research design be improved to mitigate these

   factors?

Finally, the conclusions drawn from the qualitative comparison between

the control and treatment sections of the course's student data, and the

qualitative-quantitative comparison were brought together to form a final student

experience analysis presented in Chapter 4.

6c. Individual Course Analysis Protocol

These activities were conducted for each instructor's course and

associated data. Each course analysis began with a review of the three interview

transcripts and their instructor profiles. This was followed by a review of the

courses qualitative and quantitative student data and their respective analyses,

comparison of the control and treatment data, and comparison between the

qualitative and quantitative results, all of which are presented in Chapter 4. The

analyses for the Instructor and Student data were compared and conclusions

were produced using the following questions to guide the process:

- How does the instructor's sense of their students' experience differ

   or align with what students expressed in the course?

- How does the instructor's sense of their students' understanding of

   the relevant course content differ or align with what students

   expressed in the course?

- How did UDL's application affect the faculty and student experience in the course?

- How can we describe this study's social validity?

6d. Summative Analysis Protocol

The final activity of this research involved synthesizing and reconciling the analyses from both participant instructors' courses and connecting them back to the source literature. Common themes, discrepancies with established research, insights, challenges that may inform future research will be discussed. Implications for institutional practice, and policy were discussed and additional literature further framing the results was incorporated as needed. The results of the summative analysis will constitute Chapter 5 of this dissertation. The following questions were used to guide this discussion:

- How does this study confirm or contradict other similar research?

- How could this methodology be improved to resolve or clarify inconsistencies?

- How could the methods used in this study be adapted into practice for engaging faculty?

- How effective was the plus-one method for introducing instructors to UDL?

- What implications does this study have from a policy-perspective for leaders who wish to ensure equity or accessibility of their

institutions' academic offerings?

Risk, Protection, & Confidentiality

A large amount of digital material was accumulated by this study. The storage

endpoint for all data was a private Google Shared Drive, however there was a

need for short-term intermediate storage for some types of media. Each type of

media collected over the course of this study is listed below along with the

protocols which were followed to protect the confidentiality of the participant

instructors and their students in the transport and storage of the digital materials

used in this research. The names of the courses involved in the study will not be

used, and instead be referred to as "Course A" and "Course B." Instructors and

students will receive pseudonyms and unique anonymous identifiers as described

in the general collection protocols detailed at the beginning of this chapter.

Research Log

Only pseudonyms, unique anonymous identifiers, or course A/B references

will be used to refer to instructors, courses, and students.

Recorded Zoom Interviews and Work Sessions & Transcripts

Recordings were downloaded to a computer from the Zoom cloud and

then the cloud versions were deleted. The computer copies were then uploaded

to the study's research workspace and the computer copies deleted. Names of

the instructor, colleagues, the course, or students were anonymized in the

transcript and stored in the study's research workspace. Initial anonymization and

correction of transcripts occurred in the institution's Kaltura video platform. The

caption files were then downloaded to a local computer for further refinement

and conversion into a transcript using the Gaupol caption editing software, and

Atom text editor. The finished transcript files were then uploaded to the research

workspace, imported into the Interview Analysis Workbook, and the Kaltura

versions of the videos deleted. This circuitous effort was done to prevent

identifying information from being inadvertently stored through the revision

history of the Interview Coding Workbook.

Once anonymization of a recording and transcript is completed, The

unaltered original videos and transcripts were deleted from Zoom Cloud, the

institution's video storage platform, and the local computer.

Participant Selection Survey

By its nature, the initial Participant Selection Survey could not be

anonymous. To minimize exposure, a survey closing date was established to

prevent more responses than is required. Once the study was complete and the

non-identifying data was copied and stored in a separate spreadsheet in the

study's research workspace, the survey's original collection spreadsheet was

deleted and backup responses stored in the Google Form cleared as well.

Email Communications

The text content of these, sans identifying information will be stored in the

research workspace and also noted in the research log with the timestamp the

communication began and ended. Once a thread of communication has

concluded, the original communication will be deleted. Participant instructors

were informed of these measures and that they are responsible for deleting their

copy of email exchanges to maintain the highest degree of confidentiality.

Course Modification Proposal, Coding Sheets & Other Shared Documents

Whenever this methodology required that a participant instructor consume

a working research document for this study, they received a copy of that

document as a Microsoft Word, Microsoft Excel, or PDF file. Since various Google

Workspace apps are used to store and collect the study data, allowing participant

instructors to directly access these documents would inadvertently store the

participant's real name in the documents revision and access history. This did not

occur during the study, but if the nature of the course modifications, or some

other unforeseen contingency arose which necessitated a participant having

direct access to a document, I would have created a new Google Account tied to

their own name and given the login information to the participant instructor to

use to access the relevant research material.

Student Survey, Assignments Submissions, Scores & Course Access Data

The Student Survey did not automatically collect any identifying student

information. The only way sensitive information could be disclosed through it

would be through students' deliberate use of their, the instructor's, the

institution's, or a peer's name in an open response question. To prevent this, after

a course's student data survey closes, I manually scanned the raw results for such

instances, replaced any instances of identifying information with pseudonyms,

copied the anonymized data to another spreadsheet, and deleted the original. This

is necessary since the sensitive information will still exist in the file's revision

history. Once the study is complete, the Google Form used to deliver the survey

will have its response history deleted.

Access and grade data from the institution's LMS were collected for this

study but performed by manually copying in inputting values into the collection

spreadsheets to avoid electronically reproducing students' or instructors' names.

Other Risks to Participants

Besides confidentiality, any research which involves instructors' course

content, teaching practice, and technology carries with it risks to their workload

and mental wellbeing. This was carefully considered in the design of this

methodology. Time investment on the part of the instructor was restricted as

much as possible to the production of collectible data, eg. the interview series and

work sessions. The actual direct implementation of modifications in the

instructors' course was performed primarily by me with the instructor's approval.

As this is part of my normal professional role at the setting institution, this was

hopefully a source of relief for the participant instructors, rather than a burden.

That said, I remained aware of instructors' eagerness to perform modifications

themselves and in those cases, we brokered a division of labor between us, only

to ensure that the study's research activities stayed on schedule. The sustainability of the modifications made to the course was considered as well. I ensured that participant instructors were trained so that they could implement the modifications on other parts of their course if they desired. The instructors were also informed that if they wanted the course modifications removed after the study was complete that I would perform this work for them if they wished. Instructors have full access and ownership of any new or revised course materials created as part of this study.

Lastly, the potential burden this study could have on students was considered. As such, I required that any course modifications must either leverage technologies that the institution already has access to, be composed of pedagogical behaviors on the part of the instructor, and/or consist of enhanced course materials, such as hyperlinks, visual diagrams, readability improvements, etc. Furthermore, I required that modifications could not impose any additional financial burden upon students. The above considerations were communicated to instructors during Stage 3a of the study.

Limitations and Delimitations

Being in an educational setting, this methodology was unable to provide a true experimental setting with random, representative student groups and a large sample size. Time and resources also prohibited it from being a wide-reaching effort composed of a larger number of participant instructors, and/or involving

complete, UDL-driven revision of courses. In addition, as this study was performed in real credit-bearing courses, this methodology was very time sensitive. For example, if a participant instructor wished to focus on an assignment in their course which happened too early in the semester, it would trigger a frantic effort to squeeze several stages of the study into a very short period of time. In that vein, the instructor-driven nature of the first research question's activities inherently created uncertainty in regard to which data would be collected, how to collect them, and how to analyze them in a meaningful, theory-based fashion. Due to the nature of being a study with a single researcher, there can be no inter-rater reliability in the analyses. Furthermore, the perceptions of students who did not participate in the surveys or withdrew from the courses cannot be accounted for.

Most of the delimitations set for this study are represented in Stage 1 for a number of reasons. The course interval selection criteria was in place to ensure the study could occur within a window that fit my dissertation timeframe. The choice to perform the modifications to the course, as mentioned in the previous section, was made to protect the participant instructors' time. However it was also a mechanism to reduce the dependency of the study's research activities on the instructor's time. In other words, I tried to avoid putting instructors in the awkward position of holding up the progression of the study. It is also the reason why the number of modifications to the course was limited to between three and

five.

Technology issues threatened to be a confounding factor for the purpose of this study. Jaggers (2014) noted that difficulties with technology impact the engagement of students in online courses. This had the potential to skew the observed results. Therefore, care was taken to identify and incorporate fixes or support materials to activities which may pose possible technical issues to reduce this likelihood.

Trustworthiness

To compensate for limitations and delimitations in this study, I committed myself to being as transparent and rigorous as possible in data collection and reporting activities. The mixed-methods approach balances out the quasi-experimental nature of the student-focused portion of the research by not relying solely upon quantitative data. Rather, its conclusions were derived from a triangulation of data from additional qualitative and quantitative sources depending upon the modifications selected by the instructor. Furthermore, the demographic background data from the student survey were used to explicitly define how the pairs of control and treatment course sections differed from each other and was reported upfront so as to not misrepresent the results. Finally, my involvement in the study and interaction with the participant instructors over an extended period of time was a core feature of the methodology that lends it credibility.

While I argue that the instructor-driven selection of modifications in their courses gives this study authenticity, it also inherently caused uncertainty regarding the types of data that would be collected from students. For instance, there was no way to tell whether I would be collecting textual, visual, or audio artifacts from students; all of which would require different protocols. To mitigate this, I drew upon my professional experience working with instructors at the setting institution to predict a number of different data collection scenarios. The collection protocols had inherent flexibility to accommodate as many source data-types as possible. Furthermore, I proactively detailed protocols for data collection scenarios that needed to deviate from the general collection protocols.

The selection of UDL's three-network model of the human brain as the framework for qualitative analysis provides this study with a flexible, yet consistent scheme for deriving meaning from both qualitative and quantitative data. The Affective, Recognition, and Strategic networks are well defined in existing neuroscience literature and also form the theoretical framework UDL itself is built upon, making them a natural fit for this study's data analyses. Lastly, I have outlined a detailed plan for the preservation of participant confidentiality, as well as embraced participant instructor validation of interview transcripts and student data to ensure that the impressions I draw from the interviews are accurate representations of the participants' experiences.

Role of the Researcher

Action research methodology is a core part of this study. I was not a silent

objective observer, but an active partner and guide to the study's instructors. As a

practitioner whose career revolves around online course quality, effective

teaching practice, and advocacy of the UDL framework, I needed to maintain self-

awareness to regulate my enthusiasm and allow the participant instructors to

drive the choices they make for their courses to maintain the authenticity of the

study. Finding a balance between allowing participant instructors to make their

own choices, while also serving as a guide and advisor in those choices was

crucial. I am also cognizant of how my own personal characteristics may influence

this study. I am a person who is white, of the male gender, who grew up in an

American middle-class suburb. Despite constant reflection throughout the

research process, my background may have led to narrow assumptions affecting

my analyses. Furthermore, I am also a person with a visual impairment, a learning

disability, and am a first-generation college student. I maintained awareness that

my empathy for others with these characteristics could also influence my analytic

process as well.
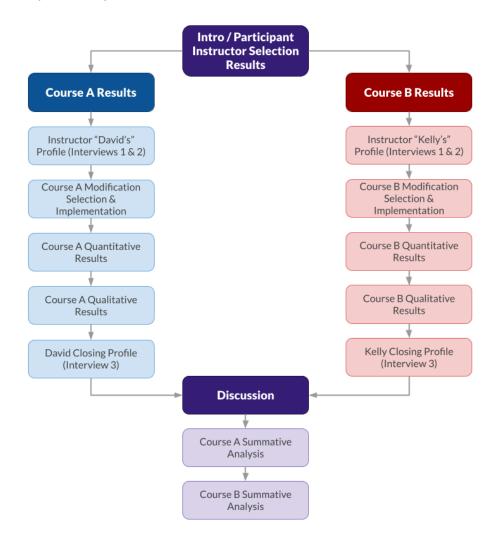
Chapter 4: Results

Organization of Data Analysis and Interpretation

The results of Stage 1 of the study are presented in the section immediately following this introduction. Each course's results are presented in their own dedicated section of this chapter. Each course's section will open with a first-person profile of the instructor which covers the first two interviews with that instructor; representing the outcomes of each instructor's in-depth interview series (Stage 2 and Stage 6a of the methodology). Following that, a narrative from my perspective describing the thought process, selection, and implementation of modifications to the course is provided, representing the results of Stage 3 of the methodology. After the modification details, quantitative results from the course are presented, followed by qualitative results; both representative outcomes for Stage 6b of the methodology. Finally, each course results section will close with a first-person profile from the point of view of the instructor, representing the outcome of the third interview, Stage 5 of the study methodology. The structure of this chapter is illustrated below in Figure 4.1.

After the two sections reporting the results of each course, the Discussion section will provide my interpretation of the results from each course, both from the level of the courses themselves, how they answer this study's research questions, and any broader meaning that may be derived from them on the whole, which covers the outcomes for Stage 6c and 6d.

Figure 4.1

Chapter 4 Map

Finally, the voice or perspective of the writing in this chapter changes periodically.

I have included parenthetical indicators to the section headings whenever one of

these shifts occurs. Sections with a heading that includes "Instructor Perspective"

are written from the instructors' first-person perspective in the style of Seidman's

(2006) interview profiles. Sections with the "Learning Designer Perspective" are

from my perspective and professional role as a Learning Designer to expose my

decision making and thought process during the work sessions with the

instructors. Lastly, sections with the "Researcher Perspective" are also from my

perspective, but within the paradigm of qualitative research results reporting.

How the Qualitative Results are Reported

There is a certain amount of overlap between the modifications in both

courses in terms of their alignment to the UDL framework. A great deal is open to

interpretation, but the rubrics provided in Chapter 3, tables 3.9 and 3.10 are my

attempt at being as systematic about it as possible. The qualitative statements

collected from the student surveys were each coded with two parallel categories

independent of each other. In addition to coding the data according to UDL-

aligned course elements, a parallel "Modification" category was also used in an

attempt to identify statements which may have been influenced by a

modification. In the case of the control sections, I gave statements a modification

code if the course element the student referred to fell within the scope of

something modified in the treatment section. If you recall from Chapter 3, I chose

to use these parallel categories to add a layer of trustworthiness to my analysis of

the qualitative data due to the vagueness of many student statements and my

own bias as the researcher, and to check my own observations. The qualitative

reporting sections of this chapter for each course will be divided between

reporting the control and treatment results with the data sorted by the Course

Element category, and then re-examined through filtered through the lens of the

Modification category. Figure 4.2, found below, is repeated from Chapter 3 as a

reference for the reader to review how this qualitative student data were coded

and categorized. When describing the connections between course elements and

the outcome expressed by the student, I use the terminology "in-network" and

"cross-network." The former means that the course element and the outcome are

aligned with the same UDL network, such as a Strategic-aligned course element

with a Strategic-aligned outcome. Cross-network means that the student

attached a course element aligned with one UDL network with an outcome in a

different network. For example, an Affective-aligned course element inducing a

Recognition-aligned outcome. Figure 4.3 is a simplified version of Figure 3.3

which illustrates the coding of a student statement under the UDL-QAM.

Figure 4.2

UDL-Aligned Qualitative Analysis Model
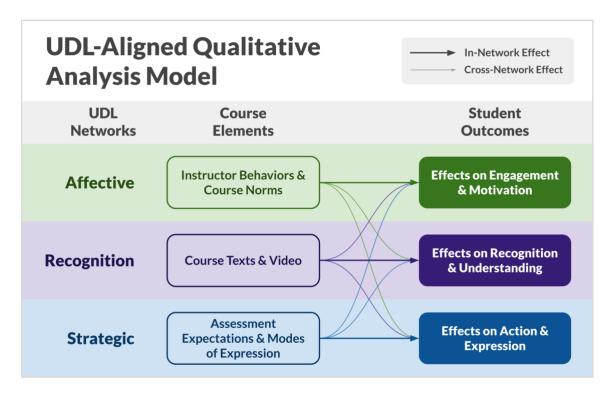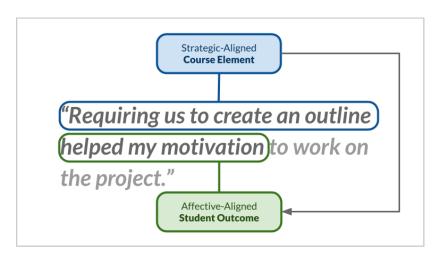
Figure 4.3

Statement Coding Example
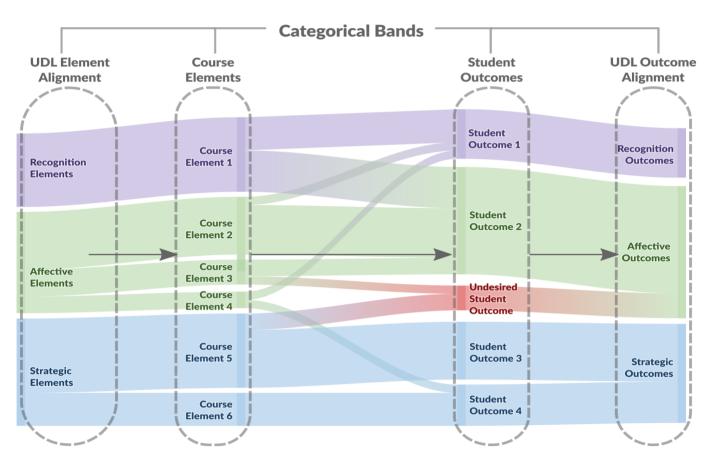
Reading the Qualitative Statement Summary Diagrams

The themes described in the qualitative sections of this chapter are accompanied by alluvial diagrams, also referred to as "sankey" diagrams, to visualize how the codes work in concert to create the observed themes. This type of plot is designed to show the relationship between multiple levels of categorical variables. In the context of this study, the quantity being measured in those diagrams is "number of student statements." The diagrams should be read from left to right. Each bending "link" passes through a categorical "band" which splits or combines the flows based on the value for that category the statements are coded with. The thicker the link, the more statements are contained within it. An annotated example of one of these diagrams is shown below in Figure 4.4. Finally, readers may explore the anonymized data using the same tool I built to generate the alluvial charts in this dissertation on my personal website, https://mmatis.net/udl/dataexp.

Figure 4.4

Example Qualitative Alluvial (Sankey) Diagram

Interconnectivity Between the UDL Networks

The qualitative coding schema used in this study allows researchers to visualize how certain actions within a course affect students. This can be further generalized by using UDL as the framework for classifying course elements and the outcomes exposed through students' statements. The result reveals the interconnectivity between the three networks of the UDL Framework. Figure 4.5 shown below plots all of the data from all of the sections in the study in an attempt to make some observations on how course elements affect students as described using this study's UDL-based conceptual framework. The second column to the left, is a generalized "Course Element Group" code category created to be generalizable across courses. In the column second to the right is the "Effect Summary" category. This sorts all of the student statement codes into UDL-based negative or positive values that are also generalizable across courses.
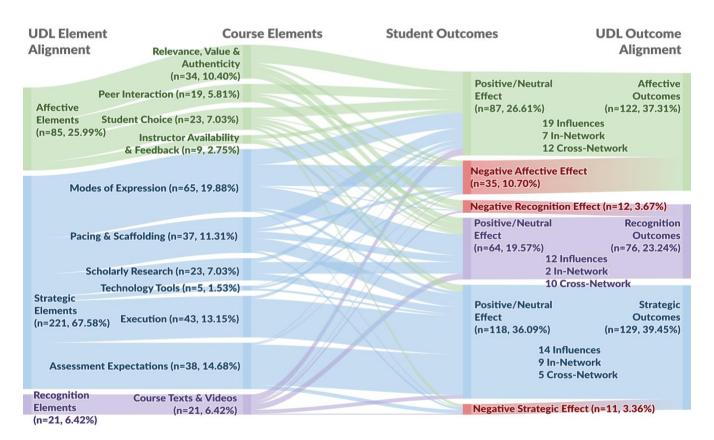
The first, most striking observation is that the Recognition outcomes are overwhelmingly influenced by Affective and Strategic course elements. I interpret this to mean that the implementation of course activities and the Affective elements, such as peer interaction and student choice, have more influence over what students learn than the course readings and videos. Conversely, Strategic outcomes appear to be primarily influenced by in-network effects from Strategic course elements. This association may be somewhat over-emphasized, as the "Execution" code is not itself a course element, but denotes a statement that is a

rote exposition a student provided of their process for completing an activity.

Strategic and Affective course elements both have broad influence across all

three networks of outcomes. These observations validate the UDL Network

Interaction Model presented in Chapter 3, and is repeated on page 3 of this

chapter.

Figure 4.5

Study-wide Holistic Qualitative Overview

Sorted by Course Element Group
66 Students, 327 Statements

IRB Approval, Participant Instructor Selection & Onboarding

After securing IRB approval in November 2020, a request for participation was sent out to the institution's faculty. This initial recruitment attempt yielded seven interested participants. After applying the selection criteria described in Phase I of the methodology, I selected, engaged and secured the participation of two instructors. However, the original second instructor had to drop out of the study due to a schedule change. Since no other interested instructors in the pool fit the minimum criteria of the study, I executed additional recruitment measures to increase the selection pool. These efforts included reaching out directly to instructors I work with frequently in my role as a learning designer. I also performed searches of the institution's course catalog to compile a list of instructors teaching sequential sections of the same course during Spring and Summer 2021 and reached out to them directly. These extra recruitment efforts yielded an additional three instructors interested in participating in the study, one of which met all of the selection criteria and whose course was an interesting contrast to the first. Table 4.1 lists the core attributes for the two courses and Table 4.2 documents David and Kelly's responses to the Plus One exercise questions in the selection survey.

Table 4.1

Participant Instructor & Course Basic information

Instructor Pseudonym	Course	Section Duration	Control / Treatment	Course Modality	Field	Level	Exp. Enrollment
David	A	14-weeks	Spring 2021 / Summer 2021	Online Asynchronous	Engineering	Undergraduate	12+
Kelly	B	7-weeks	Summer 2021 1st Session / Summer 2021 2nd Session	Online Asynchronous	Nursing	Graduate	30+

Table 4.2

Responses to Pedagogical Application (Plus One) Questions (Q6, 7, & 8)

Instructor Pseudonym	What aspects of your course do your students regularly have questions on consistently every semester?	What concepts do students regularly get wrong on assignments, quizzes, or exams consistently every semester?	What concepts or topics do your students consistently ask for explanations in a different way than the one you provide?
David	Discussions are usually an issue. Most engineering courses are quantitative -based	I don't always get complete answers to essay questions	I am adding ethics to the course this term. I imagine this will create some questions
Kelly	Questions on filming/recording the teaching video and difficulty in sending a video to assignment link.	Students are sharing responses from previous semester, so I need to change the quizzes and assignments from the previous session.	Pedigree assignment and application of pharmacogenomics to cases. Note that I will be having a graduate student working with me on the second 7 week summer session NUR 424 for her teaching practicum. She will be engaged in creating new lectures, assignments, and tests on some of the modules.

Table 4.3

Participant Pair Viability Assessment

Instructor Pseudonym	Course Interval	Minimum Estimated Enrollment	UDL Coverage Potential	Participant Total
David	3	1	2	6
Kelly	1	2	2	5
			Participant Pair Viability Score	11

After using the Participant Pair Viability Rubric described in the Stage 1 methodology to score the course's Course Interval and Minimum Estimated Enrollment, I determined the Pedagogical Applicability criterium through a cursory analysis of the two instructors' responses to the Plus One exercise questions, (PQ6, 7, & 8). With few instructors to choose from, I determined that the scope of both instructors' responses could have modifications implemented that aligned with at least two principles of the UDL framework, depending on the specifics which would be revealed over the course of our interviews and work together. The results from this process are shown in Table 4.3. In retrospect, the Instructor Pair Viability assessment was meant to systematically choose among multiple pairs of instructors, but due to the small pool of interested instructors, this step was moot since recruitment yielded only one acceptable pair.

After selecting David and Kelly, I proceeded to the Stage 2 methodology and reached out to each individually to ensure they were both still interested in

proceeding. I also scheduled introductory engagements with each to give them more details on the nature of the study, what I would need form them in terms of time, collect their informed consent forms, schedule the first interviews, and introduce them to the UDL Framework.

Before continuing, I would like to acknowledge that Course A's control and treatment sections each had 13 responses to the student survey, and Course B's sections each had 20 student survey responses. This fact is entirely coincidental and not an oversight or error.

Results from Course A - David's Undergraduate Engineering Course

About Course A

Course A is a fourteen-week, asynchronous online, intermediate undergraduate course in the institution's Engineering bachelor's program. The course covers economic and ethical issues related to the engineering field. Students complete regular homework problem assignments which align to the economics objectives of the course. For the ethics objectives, students have assigned readings and discussion prompts they respond to the instructor and each other in semi-weekly discussion forums. For summative assessment, students have a large research paper related to ethics issues and two large exams. The face-to-face version of the course also has a service-learning project in which students act as consultants for a number of local non-profit organizations. The results of David's first two interviews are presented below in the form of a profile

(Seidman, 2006). His third interview is presented in the same fashion at the end of the Course A section.

David's Profile (Interviews 1 & 2 - From Subject's Perspective)

Early Education.

I can go as far back as middle school. I grew up in the 1950's in a small New England town which specialized in critical tools for assembling engines. Situated in the Connecticut river valley, my town's other major industry was tobacco farming. My family was of very modest-means. Overall, I feel positive about the quality of the local school system. I had some excellent teachers in middle school, though I didn't think so at the time. One teacher of note was my 9th grade Ancient History teacher, Mr. Crowley. You would expect there to be chaos in terms of discipline when crossing the threshold of a 9th grade classroom. Not so with Mr. Crowley's class. The man had a gravitas and projected a sense of authority which compelled us to be on our best behavior. Nobody fooled around. He expected you to be there to learn. He didn't rap you on the knuckles or anything like that. I can't put my finger on it, but his demeanor was such that you just didn't mess with this guy. As a result, I learned a lot in ancient history. I'm sure that doesn't match modern techniques of teaching teenagers, but that was my experience.

I had a similar experience with a High School English teacher, Ms. Stewart. She was strict. Her class was the only 'C' I received in High School which created

a great deal of stress for me when I later applied for college. During the early

1960's it was still standard procedure to perform an in-person admissions

interview. Sweat was streaming off my forehead during mine as the college

admissions representative looked over my grades. He noted his 'C' in Ms.

Stewart's English class and could see the anxiety on my face. "Ah, you had Ms.

Stewart for English, huh?" I said, "Yup," and he replied "We mostly see C's and B's.

Maybe an A. Don't worry about it." That was the end of it and I was accepted

with no problem.

Undergraduate Education.

While most of my grades were 'A's, ultimately my choice of institution

came down to financial cost. I chose a nearby public college that was close

enough that I could commute and live at home. I couldn't afford the room and

board to live on campus and my hometown was close enough that it was not

onerous to commute. I didn't have that on-campus experience. Engineering is

such an isolating course of study because you really are under the gun a lot.

You're spending a lot of time with the books. The opportunity to make social

contact was limited to start with. Add on top of that the fact I was carpooling for

the first two years. We usually left between six and seven in the morning and

would get home about seven o'clock at night. It was a long day. The opportunity

to make any kind of lasting social relationships, or participate in informal study

groups was very difficult. In my last two years my brother and I bought a car, so

that freed up our schedule quite a bit and I was able to do some things at night on campus and on weekends.

If we had online courses and today's technology back then, my initial knee-jerk reaction is that it would have made things so much easier, but the social interaction situation would have been even worse. I would have been stuck home more, so I don't see where that would help. Maybe things like social media and smartphones might have helped. However, it would have saved a lot of time in terms of access to things like library resources. A lot of my time was spent at the library searching through the stacks trying to find what I needed. In terms of curriculum, if I had the same kind of quality online courses, I feel I would have gotten the same quality of education. But I was 18 through 22 years old and I needed to grow up by having social interactions and go through the pains of getting to know a roommate. I didn't do any of that because my roommate was my twin brother who I had as a roommate from nine months before I was born!

Even though the college was close by, it was very different from my provincial home town. It was like stepping out of one economic class into another. I really learned something about the world and the professors, especially those in the engineering program really gave me a feel for the profession. I had high respect for them. One Civil Engineering professor was great at combining humor and copious examples to get you through his lectures. He was very supportive and was also known for interacting with students. If you saw him walking around

campus, he'd never be alone. He'd be surrounded by a crowd of students and he'd sit with us at the campus' coffee shop. I thought that was neat. He also credits himself for introducing my wife and I to each other.

Campus was a place where you wanted to learn. I have some natural curiosity, but this place encouraged it and gave you the tools to satisfy that curiosity on your own. The engineering labs were open so that upper-class students could go in and use the equipment at any time. The way learning happens in engineering is through "doing." Lecturing is only useful for providing context, but the actual learning happens when students take on engineering and design problems themselves. The teachers which created a learning environment where students were able to learn through doing were the ones I learned the most from. There's a Japanese philosophy I've read about: That you need to struggle in order to learn. In my field, you spend time defining and analyzing a problem, and sometimes things just don't work. There is a struggle. This philosophy dictates that a teacher should not "short-circuit" that struggle, because that's where growth occurs. The brain is like any other muscle that must be exercised in order to get stronger. When I do discussions in a face-to-face or synchronous online class and ask my students a question, I've learned to be comfortable with dead air. I don't jump right in with an answer. That uncomfortable silence is space to think about the problem and the students feeling a little uncomfortable with the silence is a motivator.

Despite my overall positive undergraduate education experience, I felt that the engineering program did short-change us when it came to the humanities. There was a big separation between engineering and the rest of campus. Engineering students were isolated and I feel that was a mistake. My granddaughter is also an engineering major at the same college and her experience is the same even today. I think it's a result of heavy coursework and internships during the last two years and they just don't have time for anything else. I was limited in the number of electives I could choose. I had to talk my way into an upper-level history course I was interested in. The humanities are what opened the door for me to understand other people and the world outside of my little town. It teaches you how to reflect. Engineers never learn that even though it's a very valuable skill.

Career & Graduate Education.

The early 1960's was an exciting time to be in engineering. The Mercury program was literally just getting off the ground and would later become the Apollo program. The Vietnam war was also ramping up, so by the time I graduated in 1964, the demand for engineers was through the roof. I could have taken twenty job interviews if I wanted to. But my good grades allowed me to be selected and hired into General Electric's Advanced Engineering Program. Each year, GE would bring in a hundred new engineers from all over the country into this program.

GE was not unique at the time. General Motors and other U.S. corporations granted accredited engineering degrees during this period. But GE took it to a much higher level. If you walked into the research lab up on the hill in Schenectady, you would see Nobel Prize plaques on the wall of the lobby. It was a very heady time. This graduate program was a "whittling down" process. The first year was called the 'A' course. The next year, the 'B' course would consist of those who passed the previous year, usually around thirty-five to forty students out of the original hundred. After that second year, there were around fifteen students left, of which, I was one. GE paid students in the program a full salary as well as covered the cost of living on the campus where the program was hosted that year. In addition to job duties, students in the program had to take five graduate courses. Every week we would work on a design problem from a GE product department. One week we might work on washing machine pumps and next might be cracks in jet engine blades, but it was always something that came out of the product departments. By the end of that week, we'd have to generate a report and on Friday the instructor would say "pass your report to the guy on the right. You now have three days to return the report critiqued and corrected." I thought that was pretty difficult at the time. I had a hard time with it. But it was very instructive.

When not doing graduate coursework, my job with GE afforded me the opportunity to work with some of the most renowned heat transfer experts in the

world, essentially right out of college. It was absolutely phenomenal. Unlike my

undergraduate experience, though, this time I lived on campus; attending classes

during the day and doing coursework at night. It was a difficult time. I was newly

married at the time and my first child was born at the very beginning of the

program, but ultimately, I maintained a 'B' average and obtained my Masters in

Mechanical Engineering. Of the remaining cohort, five others went on to a PhD

program, but I chose not to. I did my doctoral work later. I studied the effect of

management structure on injuries. I collected a lot of quantitative data initially,

but then I had to delve into more qualitative territory to learn about my subjects'

stress factors and social dynamics. It was very different from what I was used to.

Transition to Teaching.

My time at GE also gave me my first experience teaching. I needed to take

a GE license exam in order to progress in my career. However, by that point, I had

been out of school for six years and had not used a large portion of the material

on that exam. To prepare for it, I volunteered to teach in GE's apprenticeship

night courses. I had no formal education or experience in teaching other than

what I observed of my past mentors. It was my first time and I was learning on the

job, and I got terrible reviews from students. It took me a long time to learn how

to teach well.

My Ph.D in Work Environment, better known today as Occupational

Health, didn't prepare me for teaching either. You're expected to become an

expert in your field so you can transmit that expertise to students, but you're not taught how to do it. It's a real problem. I have gone around and around on this a number of different times with colleagues in my department. I've suggested we get involved with [the institution's teaching and learning design unit] or get some people in the education department to come over and talk about teaching at faculty meetings. They're trying to teach and there's things that can make the job a lot easier with just a little bit of time to learn some things.

Personally, I've learned to leverage the resources around me to learn how to teach effectively. Much of what I know today was acquired by working with colleagues with formal education in the practice of teaching. Several years ago, I had a colleague with her doctorate in education look at one of my courses. She said things like, "In the syllabus, how did you scaffold the requirements?" I said, "What do you mean by 'scaffold'? I'm not building a house!" She said, "Oh. Come on in, we'll talk."

So I spent several lunch periods with her. She went through how you scaffold a course, how you look at the requirements, how you spread those requirements through the course, how you make sure that the assessments are assessing those requirements, and how you build a syllabus. I never knew that! Nobody ever showed me how to do it. I value people that are willing to take the time to actually show me how to do it. Without that your class kind of wanders really doesn't have a focus.

More recently, I was asked to deeply integrate ethics into the curriculum for Course A. Not as a superficial topic, but as a theme running throughout the entire course. Once again, I worked with a fellow professor with a formal background in the practice of teaching to develop a rubric for the course discussions, as well as how to use it to assess students. After a few rounds of refinements, the ethics-integrated version of Course A was approved by the university.

Entrance into Online Learning.

My transition to teaching online happened in 2005. A prior institution I was working for decided they needed to take their Masters of Public Health program online. What's more, in order for the online version of the program to be competitive, they needed to cut the courses down to eight weeks, but still be equivalent to three-credit graduate courses, so they could adapt the program to a six-turns-per-year model. I had great difficulty with that eight-week requirement. It ultimately led to me pulling the occupational health aspects of the course into a separate elective course.

The institution used WebCT as its learning management system (LMS) at the time and it was clunky. The only piece I was responsible for building was the PowerPoint presentations, however "ed-techs" helped me create voice-overs for the presentations and post assignments on the platform week-by-week. The ed-techs were not repurposed IT staff, but rather individuals with formal training in

the education field. Essentially, I provided the content and the institution's staff

posted it in the online course due to the user-unfriendliness of WebCT.

Eventually, WebCT was replaced with Blackboard which was an

improvement over in terms of usability. However, this better usability triggered a

shift where the institution started training professors how to build courses and

post content in the LMS themselves. At the beginning of this phase, I estimate

that the work of building a course was 30-40% effort by the instructor and 60-

70% done by an ed-tech. Over the course of this transition, the workload flipped

to the instructor doing 60-70% of the work. Today, I feel 90% of the work is done

by the professor. Pedagogically, the shift to online teaching taught me to rely less

on recorded lectures and more on homework. I also learned to rely more upon

email and discussion boards to maintain contact with students.

Retelling and Reflection on Course A, the Engineering Course.

The integration of ethics in this course was a request from the university,

and while it wasn't my choice, I recognize it as necessary in order to avoid packing

another three-credit course into an already overloaded program. I'm committed to

making its integration meaningful and worthwhile. So far, my success at

integrating ethics has been fair-to-middling, though not as well as I would like. I've

gotten some decent research papers on topics like Artificial Intelligence from

students. Another issue I've been using as a backdrop for the ethics theme is the

ongoing saga of the Boeing 737. I've provided several readings to students on it

and had them discuss who is at fault and why the issues have not improved. I've

also invited a colleague from the philosophy department to talk to my students

about the history and philosophy of ethics. This is an important addition because

this colleague is more well versed in the foundation and history of ethics going

back to Aristotle than I am. I just don't have that background.

I do not feel my discussions do what I want them to do. They are this

course's weakest area. They don't draw the students in except for the certain

discussions which are hot button issues. Those do get good results in terms of

students' initial posts. I'm looking for more involvement from the students. More

reflection and deeper thought in the upper levels of bloom's taxonomy. I want

them to synthesize and analyze. I want them to be thinking at a higher level in the

discussions than I'm getting right now, especially on the ethical issues.

I think time is one of the big issues and is the reason I don't get the depth

I'm looking for. Thinking about my own life at that age, these are 20-year-olds and

even people returning from the army in their 30s. They are time pressed. Most of

them are working jobs and taking this course at night and doing whatever they

can online. So, they try to get this assignment done as quickly as possible and

move on to the next class. I only have a couple fifteen or twenty-minute lectures

each week. The discussions and reading take a lot of their time. I've gotten

positive feedback from students on the ethics textbook because it's so different

from what they have to read normally. It's a well written book with interesting

cases. I ask them to read thirty to forty pages in that book, plus thirty to forty pages of the economics textbook, plus doing the homework in the economics book. They have to set up excel spreadsheets and work through them. This class takes time and I don't think there's any other way to put it.

I also want them to start getting to know their classmates as if they were working on a team in the industry, and I'm not getting that. For example, there's a movie I have them watch called "All My Sons." It's a 1948 movie based on an Arthur Miller play. It takes place during World War II and follows a businessman whose company produces engine parts for the U.S. Army Air Corps. He willfully ships an order of defective engine blocks and as a result, 21 planes crash-- one of which happened to be carrying his son who was serving in the war. In the discussion board, I have my students discuss the ethical issues presented in the film, such as the conflict between individual rights and obligations to one's community and society. I've used this same activity with the face-to-face version of the course, but have gotten very poor discussion out of it. The activity has worked better in the online version of the course. Students provide much higher quality initial responses to his prompts about the film, but poor peer-discussion. I suspect it's because the online version is graded, while the in-person version is part of his normal in-class lecture. Also, many of my students are introverts and they're not going to raise their hand and offer any suggestion when they can be embarrassed in class, whereas online that's not a problem. I want to take the

"nerd" factor out of engineering. I think we can come up with a better design for the online discussions and social barriers can be overcome in the face-to-face version of the course.

Course A (Undergraduate Engineering) Modification Selection & Implementation (Learning Designer Perspective)

In addition to the interviews, David and I met for several work sessions to narrow down the area of Course A we would apply UDL to. Prior to the first work session, I examined the Spring 2021 iteration of his course, his syllabus, and reviewed the content of the second interview which went in depth on his responses to the Plus-One exercise in the selection survey. It was clear from David's interviews that Course A's discussion forums were the area he wanted to focus on, so there was no need to pitch multiple potential areas to focus on. We focused on examining his discussions through the lens of UDL and I prepared a proposed list of modifications that would address his concerns. Table 4.4 contains the relevant portion of the final, abridged Course Modification Proposal David agreed to. The full version can be found in Appendix I.

Table 4.4

Abridged Course A Modification Proposal

Course A Modifications

Scope of Modifications: Course Discussions will be modified to add options for expression with accompanying technical and pedagogical supports. The goal being to stimulate more thorough/thoughtful posts and richer dialogue between students.

Parenthetical numbers reference applicable UDL Guidelines and Checkpoints.

UDL Principle I. Multiple Means of Engagement (Affective Network)

- **Modification A1:** Tune discussion prompts to connect to personal experience and interpretation. **(7.1)**

- **Modification A2:** Provide a "lead-in" on discussions prior to questions to give them context. This can either be a very short video clip or just a couple sentences. **(7.2)**

- **Modification A3:** Encourage deeper dialogue through a revised discussion rubric and requiring students to write a "circle-back" post to reply to any peers that responded to their initial post. **(8.3)**

UDL Principle II. Multiple Means of Representation (Recognition Network)

- **Modification A4:** Change raw URLs to in-line hyperlinks and turn text references to resources in the course into clickable hyperlinks. **(3.3)**

UDL Principle III. Multiple Means of Action & Expression (Strategic Network)

- **Modification A5:** Allow students to respond to prompt and reply to peers via written discussion post or with a video/audio recording. **(5.1)**

- **Modification A6:** Support multiple means of expression by providing a guide on using non-text tools to post. **(4.2)**

- **Modification A7:** Reinforce discussion expectations by sectioning and bulleting discussion prompts, and including links to the discussion rubric, expectations, providing exemplars, and modifying the syllabus with this info. **(6.1)**

See Appendix I for the full version of this Course Modification Proposal.

About Course A's Discussion Assignments.

The control section of Course A's discussion forums are implemented in the same way as most of the institution's online discussion forums. Students are required to post a response to an instructor prompt in the LMS' asynchronous discussion forum tool. Over the course of the week, they are also required to post a reply to one peer's initial post.

David had two primary concerns with his discussions: A lack of meaningful peer dialogue and superficial responses to his prompts. Looking at these concerns through the lens of the UDL framework, they fall primarily within the domains of the Engagement (Affective) and Expression (Strategic) principles, respectively, though there were also some other opportunities for improvement falling under the Representation (Recognition) principle as well. Through our work sessions, we compared the implementation of the discussion forum assignments in the control section with each of the UDL guidelines and we identified several opportunities for improvement. Each modification, the rationale for it, its alignment to UDL, and its execution is described below. As with any UDL-guided modification, each item was reviewed in the context of the course objectives to ensure that it either did not interfere with them, or enabled them to achieve the objective in a variety of ways.

A1. Tune discussion prompts to be more open-ended.

David himself expressed self-criticism over his discussion prompts. He suspected they might have a lot to do with the poor quality of student posts. Therefore, we set out to examine the discussion prompts themselves and attempt to improve them. Discussion prompts which would only generate one of a few restricted responses were replaced with more essential questions. For example, the original prompt used later in Table 4.6 asked students to select one of a set of "paradigms" found in their text as they apply to the "All My Sons" play. The modified version of this prompt explicitly requires students to explain why their selection fits the incidents portrayed in the performance. This modification has three relevant checkpoints in the UDL guidelines: 7.1, "Optimize individual choice and autonomy," which is part of the guideline "Provide options for recruiting interest" at the "Access" tier of the Engagement principle. (CAST, 2018; Meyer et al., 2014).

The goal with the revision of the discussion prompts was to make them more open-ended to facilitate more connection to students' personal lives, give them some choice in what they wrote about, and reflect on why they made those choices. Of the seven discussions in the course, only three required major changes to the actual question asked. There is a table comparing an example of one of the Course A prompts at the end of the Modification Selection & Implementation section.

A2. Discussion Lead-In Video.

Course A's discussion prompts in the control section of the course were text only. UDL's first principle, "Provide multiple means of engagement" is aligned with aspects of a learning environment which recruit students' interest, help students stay engaged and motivated, and ideally give them the tools to self-regulate and reflect. Essentially, this principle is concerned with how students "feel" about various aspects of the course, which in turn affects their engagement with learning activities. Specifically, this modification aligns with checkpoint 7.2, "Optimize relevance, value, and authenticity," under the "Provide options for Recruiting Interest," guideline.

Outside the context of research pertaining specifically to UDL, the use of video to increase the sense of psychological "closeness" or immediacy of the instructor to the student (Deschaine & Whale, 2017; Draus et al., 2014; Ramlatchan & Watson, 2020). This idea aligns well with checkpoint 7.2 of the UDL Guidelines, "Optimize relevance, value, and authenticity," which is under the "Access" tier guideline "Provide options for recruiting interest" (CAST, 2018; Meyer et al., 2014). As such, I recommended that David record short, informal videos to include at the beginning of each discussion forum prompt to augment the text prompts. I provided David some brief technical training in the use of the LMS' "video note" feature to accomplish this and he reliably recorded a video prior to releasing each of his Course A's discussion forums during the term the

treatment section of the course ran.

A3. Encourage deeper dialogue.

In our interviews and work sessions, David expressed an urge to see collegial peer dialog in Course A's discussion forums. This desire aligns to UDL checkpoint 8.3, "Foster collaboration and community," which is under the "Internalize" tier guideline, "Provide options for self-regulation" (CAST, 2018; Meyer et al., 2014).

The discussions in Course A were graded using a rubric whose criteria covered the nature and content of student posts from an internal perspective. In other words, it focused on the students' own work process and did not assess their interactions with others. Therefore, students had less of an incentive or little instructor-led guidance on how to have meaningful dialogue with each other. To remedy this, David and I replaced the last criteria of his discussion rubric with one that better addressed peer interactions. Many of the aspects of that criteria were covered in other criteria, and what wasn't, was shifted to more relevant criteria in the rubric. The results of the relevant section of the rubric are shown in Table 4.5 below.

Table 4.5

Criteria 5 of Course A Discussion Rubric

Criteria	Level 1 (6pts.)	Level 2 (8pts.)	Level 3 (10pts.)
Original (control) Criteria 5 of the Discussion Rubric			
Demonstrate effective oral and written communication that draws on the higher-level cognitive skills: analysis, synthesis and evaluation. (See below how these critiques would be evaluated numerically.)	Composition and research skills do not reach college level capability.	Composition is satisfactory, but analysis and synthesis of solutions does not show an understanding of the variables that can exist. Also, citations are not from peer reviewed sources	Compares their own framework to that featured in the course and shows how it relates to themes of the course.
Modified (treatment) Criteria 5 of the Discussion Rubric			
Constructive peer feedback which focuses on shared growth and constructive critique.	Replies to peers lack a constructive tone and do not provide actionable feedback.	Responses to peers are positive but have feedback that does not give peers anything to build on.	Tactfully provides critique of peers' work and/or provides actionable feedback to build on.

In addition, when examining the control section of Course A's discussions, I noted that at best, the threads for each discussion forum were exactly two posts deep: an initial student post, and a reply from another student, which as previously mentioned, was the course requirement. David agreed to require a third "circle-back" post in which students are required to respond to one of the students who responded to their initial post. This was an attempt to induce some

organic discussion beyond what the course required. In addition, we were more explicit about the rules students should use in selecting a peer to reply to. We asked them to prioritize the selection of an initial post with no replies first.

A4. Fix raw URLs and add hyperlinks to inline hyperlinks to course resources.

As part of the revision of Course A's discussion prompts, we changed one raw URL link in one of the prompts to an inline text hyperlink and a mention of a resource inside the course into an inline hyperlink to reduce the effort required to access the material students had to review to answer the discussion prompt. These are fairly minor adjustments included here for the sake of rigor. They align with checkpoint 3.3, "Guide information processing and visualization," which is part of the "Provide options for Comprehension" guideline at the "Internalize" tier of the Representation principle (CAST, 2018; Meyer, Rose, & Gordon, 2014).

A5. Allow students to post using video instead of text.

To provide students multiple means of expressing their knowledge, a centerpiece modification to Course A's discussions was to give students the option to post using a video instead of text through use of the LMS' "video note" tool. This aligns with checkpoint 5.1, "Use multiple media for communication," part of the "Provide options for Expression & Communication" guideline at the "Build" tier of the Action & Expression principle (CAST, 2018; Meyer, Rose, & Gordon, 2014).

A6. Provide a guide for students on posting with video.

In order to support students who might be interested in posting using video instead of text, but unfamiliar or anxious with doing so, I produced a short guide with step-by-step instructions on how to use the LMS' "video note" feature to record and add a video to a discussion post. This guide was created as a web page with screenshots annotated with the numbers corresponding to the steps in the text instructions. This modification corresponds to checkpoint 4.2, "Optimize access to tools and assistive technologies" which is under the guideline, "Provide options for Physical Action" at the "Access" level of the Action & Expression principle. This checkpoint primarily refers to physical assistive devices and equipment, however it also emphasizes that it isn't enough to simply provide a new tool to students. Support also needs to be provided in order for learners to use the tool effectively (CAST, 2018; Meyer, Rose, & Gordon, 2014). This seemed to be the most appropriate checkpoint for this modification in spirit, if not in content.

A7. Increase visibility of discussion rubric, expectations, and resources.

Many of the previous modifications would have little impact if students weren't aware of them. While some of the control section's discussion prompts mentioned the number of times and when students had to post, this information was not consistent and it was not explicitly defined in the syllabus. For the treatment course, we wrote an additional section in the syllabus detailing the

posting requirements for the discussions along with the discussion rubric, links to

exemplar posts, and info on posting with video instead of text. In addition, the

relevant information was repeated at the top of the LMS' discussion forum tool.

Finally, the discussion prompts themselves were restructured to match the new

three-post design with reminders about the nature of each post and a set of links

to the example, rubric, and video posting instructions (see Table 4.6). The

questions were also broken up into bulleted steps instead of solid paragraphs.

These modifications align with checkpoint 6.1," Guide appropriate goal-setting"

under the "Provide options for Executive Functions" guideline at the "Internalize"

tier of the Action & Expression principle (CAST, 2018; Meyer et al., 2014).

Table 4.6

Course A Discussion Prompt Example

Original (control)	Modified (treatment)
View the movie "All My Sons" In the paradigms discussed in chapter 5 which one did Joe Keller use to justify his actions? Post your response Wednesday and a response to a classmate's post by Sunday night.	**[Video intro by David]** **Initial Post** Address the following point by Wednesday: • **{View the movie "All My Sons"}**. • In the paradigms discussed in chapter 5, which one did Joe Keller use to justify his actions? • Explain your choice. **Peer-Reply** Reply to a classmate by Friday evening: • Reply to a peer who has not received a reply yet before replying to a post that already has replies. • How does your selected peer's response align with your own? **Circle-Back** Address at least one of the replies to your original post by Sunday evening: • If no one replied to your initial post by Sunday evening, reply to an additional peer instead or my reply to your post. • Either further justify your position, or continue to build upon your peer's reply. **Resources** • **{How your posts will be evaluated.}** • **{Submitting video/audio posts instead of text.}** • **{Examples of good discussion posts.}**

- *Bold text enclosed in square-braces represent an embedded video frame.*
- *Bold text enclosed in curly-braces represent inline text hyperlinks.*

Course A Quantitative Student Data (Researcher's Perspective)

Course A Student Survey - Demographics (AQ1 - AQ9).

The first part of the student survey was composed of demographic questions in order to provide a sense of how similar the control and treatment course sections were. In the case of Course A, both sections were very similar with some notable exceptions. Table 4.7 contains the frequency data for both sections. The major differences of note are that the treatment section had a more racially and ethnically diverse group of students, a higher percentage of students working full-time, and a higher percentage of students who identified as male. Despite no one choosing to disclose a disability in the treatment section, one person revealed they had reported a disability to the institution's disability services office. Please note that it is entirely coincidental that the number of student survey participants for both sections is the same.

Table 4.7

Course A Student Survey Results - Demographics

Course A Student Demographics	Control	Treatment
Student Survey Participant Count	13	13
AQ1 - Age Group: Please indicate your age:		
18 - 24	46.15%	53.85%
25 - 31	30.77%	38.46%
32 - 38	7.69%	7.69%
I would prefer not to answer.	7.69%	
39 - 45	7.69%	
AQ2 - Race and Ethnicity: How would you describe your race and/or ethnicity?		
White or Caucasian	84.62%	53.85%
Multiracial or Biracial	7.69%	15.38%
I would prefer not to answer.	7.69%	7.69%
Asian or Pacific Islander		15.38%
Hispanic or Latino		7.69%
AQ3 - Gender: How would you describe your gender?		
Male	69.23%	76.92%
Female	23.08%	15.38%
I would prefer not to answer.	7.69%	7.69%
AQ4 - Disability Status: How would you describe your physical and cognitive ability?		
I do not have a disability.	84.62%	84.62%
I would prefer not to answer.	7.69%	15.38%
I have a cognitive disability.	7.69%	
AQ5 - DSC Accommodations: Which of the following describes you?		
I do not have a disability	84.62%	84.62%
I would prefer not to answer.	7.69%	7.69%
I have reported my disability(ies) to the university Disability Services Office.	7.69%	7.69%
AQ6 - Language Status: Is English your first language?		
Yes	92.31%	84.62%

Course A Student Demographics	Control	Treatment
No		15.38%
I would prefer not to answer.	7.69%	
AQ7 - Employment: How would you describe your employment status?		
I am employed full-time.	38.46%	53.85%
I am employed part-time.	38.46%	30.77%
I am not employed.	15.38%	15.38%
I would prefer not to answer.	7.69%	
AQ8 - Enrollment: How would you describe your enrollment status with the university?		
Full-time	84.62%	84.62%
Part-time	15.38%	15.38%
AQ9 - GPA Range: Which range does your current GPA fall into?		
3.5 - 4.0	30.77%	38.46%
3.0 - 3.49	38.46%	30.77%
2.5 - 2.99	15.38%	23.08%
2.0 - 2.49	7.69%	7.69%
I would prefer not to answer.	7.69%	

Course A Student Survey - Quantitative Results.

Table 4.8 contains descriptive statistics for the Course A student survey quantitative questions. A full frequency table for the quantitative portion of the student survey can be found in Appendix A. Due to the ordinal and non-parametric nature of the data, the Mann-Whitney U test, shown in Table 4.9, was used to determine if there was a statistically significant difference between the means of student responses to questions across both sections of Course A.

Table 4.8

Course A Student Survey - Descriptive Statistics

#	Question	Section	N	Mean	SD	SE
AQ10a	(Affective) The discussions in this course made me feel motivated to work on them.	Control	13	3.846	1.345	0.373
		Treatment	13	3.308	1.437	0.398
AQ11a	(Recognition) The discussions in this course made me feel knowledgeable about the topic.	Control	13	4.154	1.281	0.355
		Treatment	13	3.615	1.387	0.385
AQ12a	(Strategic) The discussions in this course gave me a clear sense of what the instructor expected from my posts, and how to go about it.	Control	13	4.846	1.144	0.317
		Treatment	13	4.077	1.441	0.400
AQ13	I liked the discussions in this course.	Control	13	4.385	1.557	0.432
		Treatment	13	3.231	1.481	0.411
AQ14	The discussions allowed me to effectively demonstrate my understanding and ability to apply course concepts.	Control	13	4.538	1.664	0.462
		Treatment	13	3.231	1.423	0.395
AQ15	The discussions appropriately measured my understanding and ability to apply course concepts.	Control	13	4.538	1.198	0.332
		Treatment	13	3.385	1.502	0.417
AQ16a	I felt the discussions are set up in a way that met my personal learning needs.	Control	13	3.923	1.706	0.473
		Treatment	13	3.385	1.710	0.474
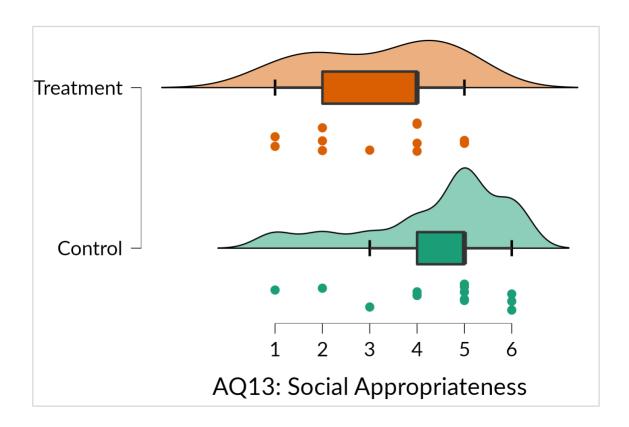
Table 4.9

Course A Student Survey - Mann-Whitney U Test

#	Question	U	p	Rank-Biserial Correlation
	UDL Aligned Questions			
AQ10a	(Affective) The discussions in this course made me feel motivated to work on them.	103.5	0.324	-0.225
AQ11a	(Recognition) The discussions in this course made me feel knowledgeable about the topic.	100	0.427	-0.183
AQ12a	(Strategic) The discussions in this course gave me a clear sense of what the instructor expected from my posts, and how to go about it.	111.5	0.154	-0.320
	Social Validity Questions			
AQ13	I liked the discussions in this course.	122.5	**0.049**	**-0.450**
AQ14	The discussions allowed me to effectively demonstrate my understanding and ability to apply course concepts.	126	**0.033**	**-0.491**
AQ15	The discussions appropriately measured my understanding and ability to apply course concepts.	121	0.058	-0.432
	Perceived Learning Needs Question			
AQ16a	I felt the discussions are set up in a way that met my personal learning needs.	101	0.403	-0.195

Note: For the Mann-Whitney test, effect size is given by the rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."
*p < .05
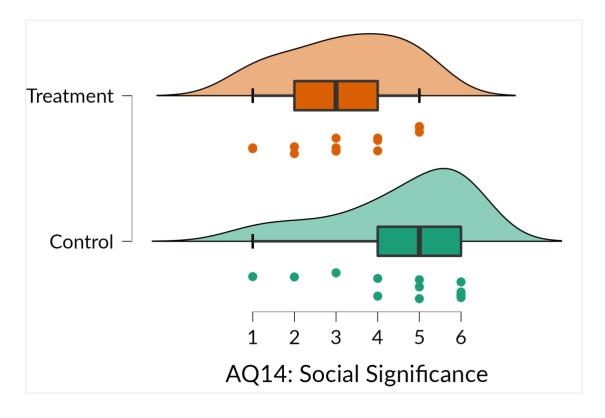
Two questions produced a statistically significant result. AQ13, "I liked the discussions in this course" showed a medium-negative effect in the treatment section (U = 122.5, p = .049, r_{rb} = -0.432). AQ14, "The discussions allowed me to effectively demonstrate my understanding and ability to apply course concepts" also produced a statistically significant medium-negative effect (U = 126, p = .033, r_{rb} = -0.491). Figures 4.6 and 4.7 visualize the significant results for AQ13 and AQ14 using rain cloud plots.

Figure 4.6

Rain cloud plot of AQ13: Social Appropriateness

Figure 4.7

Rain cloud plot of AQ14: Social Significance

Course A Other Quantitative Results.

There was no statistically significant difference between students'

discussion grades between the sections, as shown below in Tables 4.10 and 4.11.

Each section had one grade of zero which was excluded from the data set.

Table 4.10

Course A Discussion Grade Descriptive Statistics

	Valid	Mean	Std. Deviation	Minimum	Maximum	Std. Error
Control	14	73.19	24.579	31.33	98	6.569
Treatment	17	74.608	24.338	26.67	98.89	5.903

Table 4.11

Course A Discussion Grade - Mann-Whitney U Test

	Statistic	p	Effect Size
Discussion Grade	113	0.827	0.05

Note: For the Mann-Whitney test, effect size is given by the rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."
*p < .05

In addition to grade data, the quantitative difference between various dependent variables in the sections' discussion forum threads was also examined. Table 4.12 below lists the variables which were analyzed and their definition. A Discussion thread is composed of an initial detailed post made by a student and the subsequent replies to that post from other students. The descriptive statistics and results of the t-test are below in Tables 4.13 and 4.14, respectively.

Table 4.12

Course A Discussion Thread Variable Definitions

Dependent Variable	Definition
Initial Post Word Count	The number of words in the initial post by the student who started the thread.
Peer Replies	The number of replies to the thread's initial post **by other students**, excluding those by the instructor.
Initial Poster Replies	The number of replies by the thread's initial posting student in reply to other students who replied in their thread.

Table 4.13

Course A Discussion Thread Descriptive Statistics

	Section	Threads	Mean	Med.	S.D.	Min.	Max.	Sum
Initial Post Word Count	Control	79	306.949	281	146.235	95	765	24249
	Treatment	94	316.574	301.5	144.395	88	980	29758
Peer Replies	Control	79	0.848	1	1.014	0	4	67
	Treatment	94	1	1	0.464	0	3	94
Initial Poster Replies	Control	79	0.051	0	0.221	0	1	4
	Treatment	94	0.745	1	0.485	0	2	70
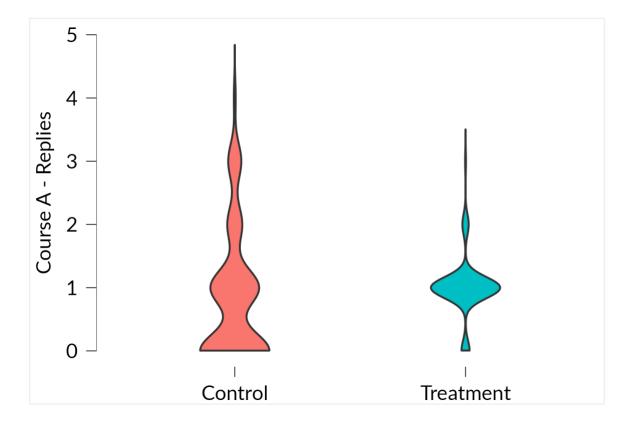
Table 4.14

Course A Discussion Thread - Mann-Whitney U Test

	U	p	Rank-Biserial Correlation
Initial Post Word Count	3516	0.549	0.053
Peer Replies	2866	**0.003**	**0.228**
Initial Poster Replies	1211	**<.001**	**0.674**

Note. For the Mann-Whitney test, effect size is given by the rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."
*p < .05

There was no statistically significant difference between the Initial Post Word Count between the two sections. However, the other two variables produced statistically significant differences between the sections. The count of Peer Replies showed a low-positive effect (U = 2866, p = .003, r_{rb} = 0.228) and is represented by Figure 4.8. The concentration of peer replies each initial post received in the course also differed between the sections. In the control section, most students' initial post went un-replied to or at best received one reply. In the treatment section, nearly all initial student posts received at least one student reply.

Figure 4.8

Violin plot of Peer Replies
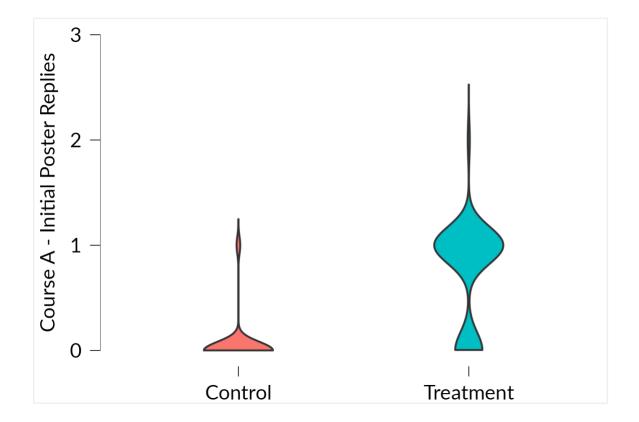
Initial Poster Replies showed a high-positive effect (U = 1211, p = <.001, r_{rb} = 0.674). Recall from table 4.12 that "Initial Poster Replies" are the count of posts the initial poster of a discussion thread made to a peer that replied to their initial post. For example, a student named Phil starts a new discussion thread with his responses to the discussion prompt for the week. A peer named Andrew then replies with feedback to Phil's initial post. Later that week, Phil replies to Andrew's reply, responding to Andrew's feedback. That third-level post from Phil would make the "Initial Poster Reply" for Phil's discussion thread equal to 1.

In Figure 4.9, the bulge near zero on the y-axis indicates that nearly all of the threads in the control section had no Initial Poster Replies, while in the treatment section, the vast majority of threads received at least one Initial Poster Reply. This is really not a surprise considering David and I made it a requirement for everyone to reply at least once to anyone that replied to their initial post as part of the A3 modifications. While the change to posting requirements makes itself quantitatively present in the data, this is not an indicator of the desired effect which was to coax deeper dialog from students in the asynchronous discussions. Rather it simply demonstrates students' willingness to follow directions. Had actual, organic discussion occurred, the treatment side of the plot would have more bulges along the y-axis greater than 1, signifying varying discussion depths throughout the threads. Instead, students did the exact minimum that was required of them to get full credit on the assignment.

Figure 4.9
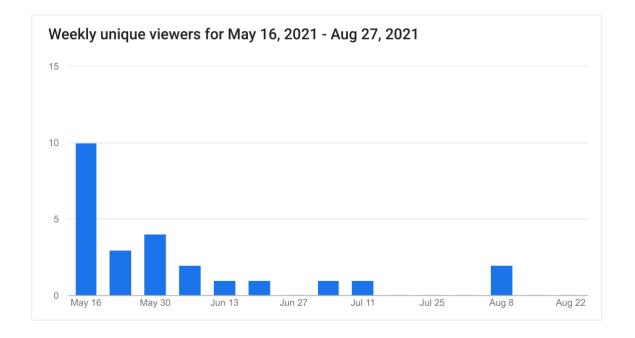
Violin plot of Initial Poster Replies

Finally, data were collected on student access to the Discussion Exemplars document created as part of the modification of David's discussion assignments in the treatment section. This metric has no comparable data in the control section, but is provided here as evidence that this part of the modification was accessed by students. The access pattern by students is shown below in Figure 4.10.

Figure 4.10

Student access to Discussion Exemplars in treatment section

Course A Qualitative Student Survey Results

The analysis of the qualitative portions of the Course A student survey

yielded 38 codable responses from the control section and 65 from the treatment

section. The three tables below provide specifics about the instrumentation and

general overviews of the results. Table 4.15 lists the open-response qualitative

questions from the Course A student survey that were used to collect this date.

Table 4.16 contains a high-level summary of the data using the broad "Effect"

code category which breaks down outcomes according to whether they represent

a positive/neutral outcome, or a negative one. A full summary of the counts and

percentages for all statement codes and categories may be found in Appendix F.

Table 4.17 gives a summary of course A's students' qualitative statements

organized by their UDL-aligned course element and the UDL-aligned student

outcome.

Table 4.15

Course A Student Survey Qualitative Response Questions

AQ10b.	What aspects of the discussions and their supporting materials helped, or didn't help your motivation to work on them?
AQ11b.	What aspects of the discussions and their supporting materials helped, or didn't help in understanding the topics in this course?
AQ12b.	Briefly describe your process for completing discussion assignments. In other words, what strategies did you employ, resources you used, etc.
AQ16b.	What aspects of the discussions made you feel this way?
AQ17.	Optional: Do you have any other feedback regarding the discussions you would like to share?

Table 4.16

Course A High-Level Qualitative Data Summary

| | Course A Section | | | |
| | Control | | Treatment | |
Effect Summary	N	%	N	%
Affective Statement	15	39.47%	18	27.69%
Strategic Statement	12	31.58%	18	27.69%
Recognition Statement	6	15.79%	14	21.54%
Negative Affective Statement	3	7.89%	7	10.77%
Negative Recognition Statement	2	5.26%	5	7.69%
Negative Strategic Statement			3	4.62%
Total Statements	**38**		**65**	

Table 4.17

Course A Student Qualitative Data by Course Element

Course Element	UDL Outcome Alignment	Outcome Detail Codes	Control N	Control %	Treatment N	Treatment %
		Section				
		Affective-Aligned Course Elements				
Topics for Discussions	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			3	4.62%
		Helped Engagement & Motivation	6	15.79%	5	7.69%
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%		
	Recognition	Did Not Help Understand Topic or Concept			3	4.62%
		Did Not Help with Other Course Topics	1	2.63%	3	4.62%
		Helped Understand Topic or Concept	1	2.63%	5	7.69%
Instructor Availability & Feedback	**Strategic**	Helped Understand Expectations	1	2.63%		
	Recognition	Helped Understand Topic or Concept	1	2.63%		
Peer Interaction	**Affective**	Disliked, Disengaged, Demotivated, Indifferent	1	2.63%	1	1.54%
		Helped Engagement & Motivation	2	5.26%	3	4.62%
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%	4	6.15%
	Recognition	Helped Understand Topic or Concept			7	10.77%
		Strategic-Aligned Course Elements				
Execution	**Strategic**	Reviewing, Self-Monitoring, Task Strategies & Goal Setting	7	18.42%	9	13.85%
	Affective	Self-Evaluation & Self-Consequences (Reflection)			2	3.08%

Course Element	UDL Outcome Alignment	Outcome Detail Codes	Control N	Control %	Treatment N	Treatment %
Exemplars	**Strategic**	Helped Understand Expectations			1	1.54%
Instructions	**Strategic**	Expectations Too Demanding or Arbitrary			1	1.54%
		Helped Understand Expectations	2	5.26%	5	7.69%
Pacing & Scaffolding	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			1	1.54%
		Helped Engagement & Motivation			1	1.54%
	Strategic	Expectations Too Demanding or Arbitrary			1	1.54%
Rubric	**Strategic**	Helped Understand Expectations	2	5.26%	3	4.62%
Technology Usage	**Affective**	Helped Engagement & Motivation			1	1.54%
Text-Based Mode of Expression	**Affective**	Disliked, Disengaged, Demotivated, Indifferent	2	5.26%	1	1.54%
Recognition-Aligned Course Elements						
Course Texts & Videos	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			1	1.54%
		Helped Engagement & Motivation	5	13.16%	2	3.08%
	Recognition	Helped Understand Topic or Concept	4	10.53%	2	3.08%
		Too Long for a Discussion Assignment	1	2.63%		
	Strategic	Did Not Align With Discussion Topics			1	1.54%

Course A Control Section.

Figure 4.11 illustrates the results in this section. The statements with a

course element aligned with UDL's Recognition networks (n=10, 26.32%)

centered around the course's texts and videos. Specifically, most statements in

both sections pertained to the Kidder textbook. Students presented a near even

split between in-network positive outcomes and cross-network outcomes with

the Affective network. Most statements centered around the Kidder text David

assigned. Students shared that the text helped them understand the course's

topics (n=4, 10.53%), "The book is very easy to relate to and is written in a way

that is easy to understand". Those coded with an Affective outcome (9, 23.68%)

felt that the texts helped their motivation and engagement. Several specifically

complimented the Kidder textbook David assigned. "I very much enjoyed reading

the Kidder text, and found the content engaging." One student (2.63%) was

critical of one of the videos they were assigned, "Watching an entire movie to

only write a small discussion post seemed like a lot."

Statements coded with an Affective-aligned course elements (n=15,

39.47%) focused on three elements: the discussions' Topics for Discussion (n=9,

23.68%), peer interaction (n=4, 10.53%), and David's interactions with them (n=2,

5.26%). Students who mentioned the ethics theme generally felt that it helped

their engagement and motivation (n=6, 15.79%), a sentiment I coded as an in-

network outcome. "The scenarios were not often clearly right or wrong, and I

think this forced everyone to really analyze the issues and generate a good discussion that forced reflection." Of the four students who cited student interaction as the course element in their statement, two felt that interacting with peers in the discussions helped their engagement and motivation. However, one student found discussion posts "meaningless when it comes to a lot of course work." This was a difficult statement to code and I almost excluded it, except that the core purpose of text-based discussion assignments is for students to interact and learn from each other. Therefore, I coded this statement with the "Peer Interaction" Affective-aligned course element. Finally, two students noted positive outcomes related to David's expert feedback on their posts and willingness to help when contacted. One student felt that this interaction with him helped their understanding of course concepts, a cross-network Recognition outcome. The other student felt David helped them understand the expectations of the discussion assignments, a cross-network Strategic outcome.
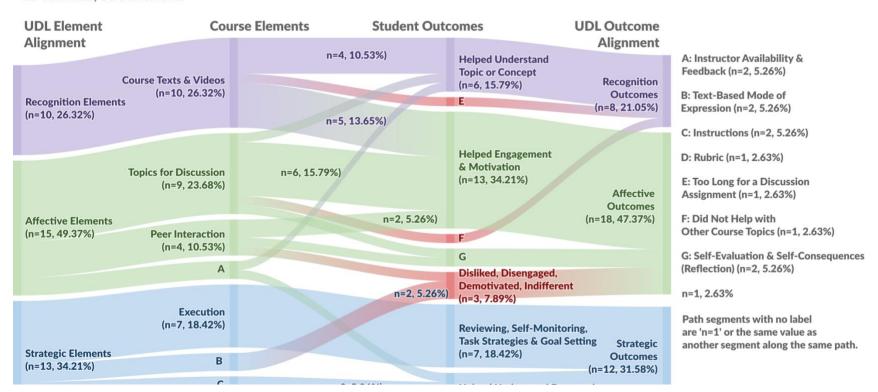
The statements coded with a Strategic-aligned course element (n=13, 34.21%) were primarily expositions of how students executed the discussion assignments, all of which (n=7, 18.42%) generally consisted of a sequence of reading or watching the assigned materials, reviewing David's discussion prompt, composing a post, and then replying to a peer. These statements were given the "Reviewing, Self-Monitoring, Task Strategies & Goal Setting" code in line with McTigh's metacognitive strategies, which I classified as a Strategic outcome. Two

students felt that the discussion instructions helped them understand what was

expected of them, while two others thought the same of the discussion rubric

(Strategic outcomes). Finally, two students demonstrated negative cross-network

Affective outcomes, specifically noting text-based, online discussions as a

demotivating factor for them.

Figure 4.11

Course A Control - Overview by Course Element

Qualitative Student Data Overview by Course Element
13 Students, 38 Statements

UDL Element Alignment | Course Elements | Student Outcomes | UDL Outcome Alignment

Recognition Elements (n=10, 26.32%)
Affective Elements (n=15, 49.37%)
Strategic Elements (n=13, 34.21%)

Course Texts & Videos (n=10, 26.32%)
Topics for Discussion (n=9, 23.68%)
Peer Interaction (n=4, 10.53%)
A
Execution (n=7, 18.42%)
B
C

n=4, 10.53%)
n=5, 13.65%)
n=6, 15.79%)
n=2, 5.26%)
n=2, 5.26%)

Helped Understand Topic or Concept (n=6, 15.79%)
E
Helped Engagement & Motivation (n=13, 34.21%)
F
G
Disliked, Disengaged, Demotivated, Indifferent (n=3, 7.89%)
Reviewing, Self-Monitoring, Task Strategies & Goal Setting (n=7, 18.42%)

Recognition Outcomes (n=8, 21.05%)
Affective Outcomes (n=18, 47.37%)
Strategic Outcomes (n=12, 31.58%)

A: Instructor Availability & Feedback (n=2, 5.26%)

B: Text-Based Mode of Expression (n=2, 5.26%)

C: Instructions (n=2, 5.26%)

D: Rubric (n=1, 2.63%)

E: Too Long for a Discussion Assignment (n=1, 2.63%)

F: Did Not Help with Other Course Topics (n=1, 2.63%)

G: Self-Evaluation & Self-Consequences (Reflection) (n=2, 5.26%)

n=1, 2.63%

Path segments with no label are 'n=1' or the same value as another segment along the same path.

Course A Treatment Section.

The results for this section are illustrated in Figure 4.12. Students in the treatment section had less to say regarding the Recognition-aligned elements of the course (n=6, 9.09%). Of those, two expressed a positive cross-network, Affective-aligned outcome (n=2, 3.08%), in that the course text helped their engagement and motivation. Two noted a positive in-network outcome (n=2, 3.08%), stating that the texts helped them understand the course topics and concepts. However, the other two statements with a recognition origin expressed negative cross-network Strategic and Affective-aligned outcomes. One student (1.56%) felt that the readings did not align well with the discussions, and the other simply felt that the materials were "bland."

Affective-aligned course elements in the treatment section saw much more attention from students. 50.77% (n=33) of the coded statements were about one of these elements. The "Topics for Discussion" code (n=18, 27.69%) had a diverse range of outcomes. There were fewer statements revealing that the Topics for Discussion helped their understanding of the course topics, a Recognition-aligned outcome (n=5, 7.69%), than in the control section. In fact, there were two new types of negative in-network outcomes which did not appear in the control data. Three (4.62%) student statements felt that the Topics for Discussion did not help them understand course topics and concepts. Another three statements expressed that the discussion themes "felt like a distraction from the other

materials." The "Topics for Discussion" code has some Affective-aligned outcomes

as well. Five (7.69%) statements were made by students which expressed that the

Topics for Discussion helped their engagement and motivation, however this is

lower than the percentage of statements in the control section that expressed

this same outcome. There was also a percentage increase in the number of

statements expressing a lack of engagement and motivation attributed to the

ethics theme of the discussions (n=3, 4.62%).

The other Affective-aligned course element, Peer Interaction, was the

origin of fifteen (22.73%) of the statements in the treatment course. This is a

percentage increase over the control section's 10.53%. Despite the more critical

statements regarding the discussion themes, a new cross-network outcome

emerged between that is not present in the control section. Seven (10.77%) of the

statements in the treatment section indicated that the Peer Interaction element of

the course discussions helped them understand course concepts and topics. One

student wrote, "Seeing different opinions and points of view helped round out my

understanding of the topics." Four (6.15%) students expressed statements which

exhibited or indicated that the peer-interaction in the discussions induced further

reflection and self-evaluation. "[the discussions] challenged my thoughts [on]

what other students in the class who might disagree would think." Three (4.62%)

of students felt that Peer Interaction helped their engagement and motivation (in-

network outcome), and one student (1.54%) disliked the peer interaction aspect

of the discussions.

The treatment section had a similar percentage (39.39%) of statements relating to Strategic-aligned elements of the discussions as the control section. Also similar to the control section, a significant number of students related an execution process I coded with the "Reviewing, Self-Monitoring, Task Strategies & Goal Setting" Strategic-aligned outcome (n=9, 13.85%). However, two (3.08%) students provided statements which went beyond a rote process summary revealed something of their internal thought process. "...after which I would reflect on what I've learned from the material and the discussion prompt and what my personal views were on the subject, and then complete the discussion." These statements were given the cross-network Affective-aligned outcome code "Reviewing, Self-Monitoring, Task Strategies & Goal Setting".
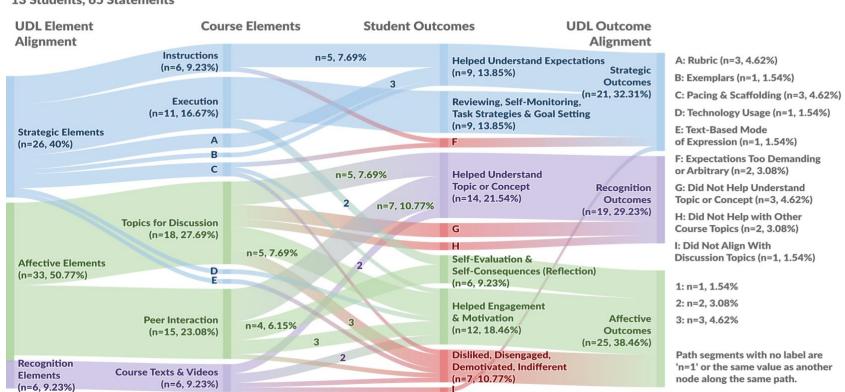
Seven (10.77%) of the statements pertained to the discussion instructions (Strategic-aligned course element). Of these, five (7.69%) of the statements regarded the discussion instructions as being helpful in understanding David's expectations (in-network outcome). This is a small percentage increase over the control section. Three (4.62%) felt the same about the discussion rubric, a small decrease from the control section. One student (1.54%) felt that the expectations for the discussions "felt arbitrary." Three statements (4.62%) related to the discussions' pacing and scaffolding. One student expressed that the way the discussions were spaced throughout the term helped their engagement and

motivation (cross-network Affective outcome). However, two students expressed different negative outcomes related to how the discussions were paced and scaffolded. One expressed frustration at the repetition and over-use of asynchronous discussions in general, which contributed to his disengagement (cross-network Affective outcome), and the other found the posting deadlines for each stage of a discussion assignment too restrictive (in-network outcome).

Figure 4.12

Course A Treatment - Overview by Course Element

Qualitative Student Data Overview by Course Element
13 Students, 65 Statements

Course A Student Qualitative Results by Modification.

This section will focus specifically on modifications A1, A3 and A7. The student qualitative data contained no evidence in regard to the impact of modifications A2, A4, A5, and A6. In terms of other data beyond the qualitative student survey that pertains to these modifications, for A2, the institution's LMS does not record statistics on the number of students who watch instructor videos recorded as an embedded Video Note. A4 was too minor of a change to show up in any data. Finally, in regard to A5 and A6, because no students in the treatment section took advantage of the ability to post video or audio instead of text for their post, those two modifications were rendered moot. Table 4.18 below summarizes the data by modification, and it is illustrated in Figures 4.13 and 4.14. Figures 4.13 and 4.14 were rendered with only data pertaining to the modifications to produce a much more succinct visualization compared to the full alluvials in previous sections. Finally, please note, the "UM" code in Table 4.18 denotes statements which pertained to a course element which was not modified. These statements were excluded from this part of the analysis.

Table 4.18

Course A Qualitative Summary by Modification

Mod	UDL Outcome Alignment	Statement Detail	Control N	Control %	Treatment N	Treatment %
Affective-Aligned Course Elements						
A1	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			3	4.62%
		Helped Engagement & Motivation	6	15.79%	5	7.69%
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%		
	Recognition	Did Not Help Understand Topic or Concept			3	4.62%
		Did Not Help with Other Course Topics	1	2.63%	3	4.62%
		Helped Understand Topic or Concept	1	2.63%	5	7.69%
A3	**Affective**	Disliked, Disengaged, Demotivated, Indifferent	1	2.63%	1	1.54%
		Helped Engagement & Motivation	2	5.26%	3	4.62%
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%	4	6.15%
	Recognition	Helped Understand Topic or Concept			7	10.77%
UM	**Recognition**	Helped Understand Topic or Concept	1	2.63%		
	Strategic	Helped Understand Expectations	1	2.63%		
Strategic-Aligned Course Elements						
A7	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			1	1.54%

Mod	UDL Outcome Alignment	Statement Detail	Course A Section			
			Control		Treatment	
			N	%	N	%
	Strategic	Expectations Too Demanding or Arbitrary			2	3.08%
		Helped Understand Expectations	4	10.53%	9	13.85%
UM	**Affective**	Disliked, Disengaged, Demotivated, Indifferent	2	5.26%	1	1.54%
		Helped Engagement & Motivation			2	3.08%
		Self-Evaluation & Self-Consequences (Reflection)			2	3.08%
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting	7	18.42%	9	13.85%
Recognition-Aligned Course Elements						
UM	**Affective**	Disliked, Disengaged, Demotivated, Indifferent			1	1.54%
		Helped Engagement & Motivation	5	13.16%	2	3.08%
	Recognition	Helped Understand Topic or Concept	4	10.53%	2	3.08%
		Too Long for a Discussion Assignment	1	2.63%		
	Strategic	Did Not Align with Discussion Topics			1	1.54%

UM = Unmodified. Data which referred to a course element that was not modified for this study.

Modification A1 Results.

A1 called for David and I to tune his discussion prompts to be more open-ended. The result of this was the appearance of three statements (4.62%) in the treatment section in which students expressed dislike, demotivation or indifference regarding the discussions (negative in-network Affective outcome). There was a percentage drop from 15.79% (n=6) to 7.69% (n=5) in the number of statements expressing that the discussion questions helped their engagement and motivation (cross-network Strategic). The percentage of statements expressing frustration that the discussions did not pertain to other topics in the course also increased (cross-network Recognition). The control was 2.63% (n=1) and treatment was 4.62% (n=3). There were also three statements (4.62%) in which students stated or inferred that the discussion questions did not help them understand the topic or course concepts (negative cross-network Recognition outcome). Finally, there was an increase in the number of statements which expressed that the discussion questions helped them understand course concepts. Control had 2.63% (n=1) and treatment had 7.69% (n=5). These results are illustrated in Figure 4.13.
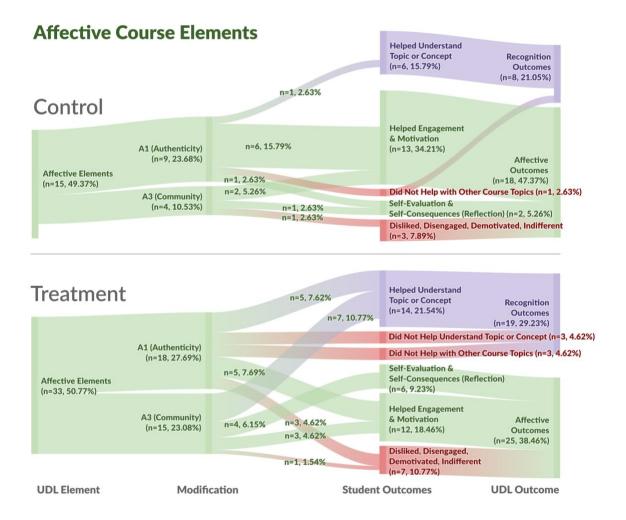
Modification A3 Results.

The goal of A3 was to improve the depth of student dialogue in the course by adding a "peer dialogue" criteria to the course's discussion rubric, and requiring students to make a "circle-back" post responding to peers that replied to their

initial post. Among the student statements attributed to this modification, there

was an Increase from 2.63% (n=1) to 6.15% (n=4) in the number of students who

indicated some form of reflection either in their discussion post or the statement

itself. There was also a contingent of seven (10.77%) students who reported that

the efforts to improve community in the discussions helped them better

understand course topics and concepts. This type of statement did not exist in the

control section. These results are illustrated in Figure 4.13.

Figure 4.13

Course A Modification Effects - Affective Course Elements

Modification A7 Results.
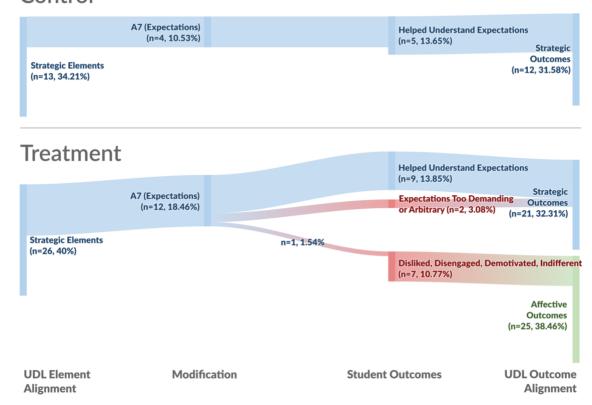
A7 required David and I to improve the visibility of the discussion rubric, instructions, expectations, and resources pertaining to the discussions. Figure 4.12 illustrates that these efforts led to an increase in the percentage of statements from students which expressed that one of these aforementioned

resources helped them understand the expectations of the discussion assignments. 10.53% (n=4) of the control section's statements shared this sentiment while the treatment section had 13.85% (n=9). However, two students in the treatment section also felt that the expectations were too arbitrary or demanding and one found them demotivating. Neither of these element-outcome pairs were present in the control section's data.

Figure 4.14

Course A Modification Effects - Strategic Course Elements

Final Interview - Post Treatment (Instructor's Perspective)

Overall impression of the Summer 2021 section.

I noticed several differences with the course during the Summer versus Spring, both in terms of the makeup of my students, as well as from the changes we made to the discussions. Though I'm disturbed because three of my students did nothing in the course from the start, yet they didn't attempt to drop or withdraw from the course. Every now and then I have a student do this, but never three in a single term!

In general, I didn't feel that the summer section did as well overall as the Spring, though I admit that I didn't specifically compare the two. I experienced more 'F's and 'D's than I'm used to. I also had to rush through the content for week 14 in order to have time for the course's final exam. I plan on reorganizing some things in the course to make more room. The summer students just didn't seem to be as "with it" as my Spring students. They seemed to really enjoy the ethics textbook. I got a lot of comments about that. I think it's because the book was a change-of-pace for them.

Instructor's Impression of Discussion Modifications.

General impressions aside, I think the discussions went well. I did see an improvement in reflection with the students in the summer, and the posts are better. The discussion questions are now far superior to what they were before. I think the reflective piece was important. Even though I made some negative

comments about the students earlier, I got some excellent discussions in the

summer class. That was satisfying since it was a major change to the class this

year. I got a lot of late submissions because many of these students work full

time. Because of that, I did not burden them with any penalty for submitting late.

The class is difficult, though. It's packed with content and assignments. Doing the

intro videos wasn't onerous at all. Once I was shown how to do them, it was easy.

I wish I knew about the ability to do that earlier! It's a great way to connect to the

students that I hadn't done before. I liked it a lot.

The discussion assignments are an important part of this course. They are

used as an assessment for several of the course's objectives so they carry a heavy

burden, pedagogically speaking. Frankly, I'm pleased with some of the stuff that's

come out of our collaboration. I think it makes the discussions better, which

makes the class better. I'm trying to change the way my engineering students

think about their role in society. I want them to stop seeing themselves as "geeks

at a computer terminal" and realizing that they are part of society and the choices

they make in their professional roles will affect society in broad ways. I feel that

this class is evolving into that, which is very satisfying.

Like a lot of professions, engineers tend to associate with like-minded

people, so they're associating with other technically trained people. Think about

Silicon Valley software engineers. You're talking about individuals that are highly

paid and fairly young, so they're able to insulate themselves from a lot of what's

going on right up the street with homelessness and crime. To get future engineers

to think about those issues is important because they can do a lot to mitigate the

problems in society with their skills, but you have to get them motivated to do it. I

think UDL can help because it encourages us to find other ways of reaching

people.

It's a little hard to tell if the students found the discussions worthwhile.

Engineers are funny folks. As I mentioned, they don't look at soft issues as being

important. They look at whether they're going to get the correct answer to the

next problem, or whether they're going to design something that doesn't collapse.

They're very quantitative. So that is and continues to be a challenge.

The discussions are important and I'm glad we started with them, but it

can't end there. I've got to think about how to use UDL in the service-learning

project. That's an important part of the experiential learning piece of the class and

I'd like to figure out how UDL can help get those service learning issues across to

students. In fact, I want to feature UDL as part of my portion of the engineering

department's re-accreditation.

I thought this process was fascinating. I've always been interested in how

to make my teaching more effective. I haven't had time to take education courses,

so talking to colleagues and learning designers has been a large part of helping me

become an effective online instructor. I value this very much and I intend to use

UDL in my teaching.

Results from Course B - Kelly's Graduate Nursing Course

About Course B

Course B is a seven-week, asynchronous online graduate course in the institution's Nursing master's program. The course covers core genetics concepts and conditions stemming from abnormalities in the human genome. It does this from a clinical angle aimed at giving students experience providing genetic counseling to patients. Students complete regular homework assignments involving the reading case studies and journal articles, as well constructing and interpreting clinical heredity charts. For summative assessment, students complete a "Teaching Video" in which they select someone they know to role-play as a patient. The student then stages a genetic counseling session in which the student role-plays as a nurse educating the "patient" on a genetic condition of their choice using various instructional techniques and visual aids. The student records the session using any video-capable device and then uploads it to the institution's LMS to be graded by Kelly. The results of Kelly's first two interviews are presented below in the form of a profile (Seidman, 2006). His third interview is presented in the same fashion at the end of the Course B section.

Kelly's Profile (Interviews 1 & 2 - Instructor's Perspective)

Early & Undergraduate Education.

I went to high school in the early 1970's, before the Internet, but had regular contact with early personal computers. Learning in high school was torturous for me. The classes consisted of traditional lecture and reading-based pedagogy. My high school's lack of a path through the coursework and my teachers' unclear expectations really affected me negatively. I felt uncomfortable and unprepared going into class each day. However, I did know I wanted to be a nurse since the first grade, which was fortunate because at that time, high school guidance counselors held a lot of sway over where young women were directed in terms of career paths. It was never the hard sciences, engineering, or law. We were directed toward social work, teaching, or nursing.

For college, I went to a large university in the northeast United States. My undergraduate major was in Nursing and it was more "curriculum driven" than high school was. I feel it was effective at preparing me for my nursing clinical, which pulled prior coursework into actual field experience. The university used this field experience component in all of their academic programs. I did a lot of reading, but I had no idea what the actual experience of being a nurse would be like. I gained that through the clinical portion of my undergraduate degree. I could see the progression of my learning, unlike my high school experience. The clinical {course or learning experience] really boosted my confidence, motivated me in my

studies and improved my ability to demonstrate my learning.

If we had the same technology we do today when I was an undergraduate and had to do the program online, I would have been lost in terms of connecting with people. I would also have had trouble finding "true purpose." As a high-school graduate, I was inexperienced. It was a process to learn how to learn. I needed to become comfortable with asking questions and that would have been harder in an online environment. I never would have developed self-confidence and self-direction. I also would not have benefitted from learning from my peers. A lot of lessons are more impactful coming from a peer, rather than from an authority figure, like a parent or teacher.

Career & Graduate Education.

After finishing my bachelors and working for a short time in obstetric nursing. I joined a hospital as a staff nurse and was eventually promoted to assistant head nurse. I felt that there was more I was capable of doing in my profession. I wanted to learn more. I wanted to go beyond clinical direct patient care and be a leader; to educate and expand the clinical practice of the field. I had a wonderful mentor at the hospital I was employed with who encouraged me to go to graduate school and during the 1970's, it was possible for nurses to receive a tuition-free education, and even a stipend, to return to school. Hospitals at the time were transitioning from traditional nurse training and shaping the field to be more academic through baccalaureate and graduate pathways. It was opening up

to scientific inquiry and evidence-based expansion of its practices. Before that period, whatever you learned from somebody else, that's what you did and you didn't question it at all. For example, before I became a nurse, it was common practice for fathers to not be allowed in the delivery room and my mentor was advocating for family centered care. She encouraged me to analyze how we provided care at the time and if those practices had evidence to support them.

So, I was accepted into a graduate nursing program with a focus on maternal childhood nursing. The program was divided into three domains: Research; leadership and administration; and education and practice. Like high school, the courses were taught in a more traditional lecture format, but by this time I had developed a love of learning, and drive that kept me engaged. For my capstone, I performed a qualitative research project on adolescent pregnancy.

I think I would have been fine doing my graduate degree online if we had the same technology then. By that time, I had developed the social confidence and self-direction to persist through the program, though I still would have enjoyed the face-to-face modality more. From a pedagogical standpoint, the graduate and doctoral programs I was a student in would have transitioned very well to an online modality. They were well-scaffolded and my instructors were excellent at transmitting information via active learning rather than traditional lecture. The coursework would have translated well to online learning. Those instructors encouraged reflection on past examples and practice. They also guided

us towards new questions to help us discover our own journey.

Transition to Teaching.

After graduate school, I discovered that there was a surplus of masters-prepared nurses in my area, so I relocated to a different north-eastern state. I found a position as a Nurse Coordinator at a prenatal clinic which practiced community-based care. I was also asked by the state to become a consultant for the public health service to develop family planning and education programs for state-wide distribution. However, after three years in this role, I realized that I missed directly caring for patients. That led me back to school for a post-masters in nurse midwifery. I relocated once again to a southern state to be near the institution offering the degree. Shortly after graduating from the nurse midwifery program, I was asked to join the faculty of that institution.

The program I first taught in had a "modular" curriculum. It had specific objectives which students had to meet, with pre-planned readings and learning exercises. The coursework was a combination of lecture and case studies followed by clinical practice for which we would supervise the students. I started out part-time and also worked full-time for a private nurse midwifery clinical practice. Eventually, though, I decided to teach for the institution full-time and expanded into teaching undergraduates. I had little formal education in regard to teaching. My first master's degree consisted of some education courses that were more focused on specific nursing curriculum, rather than teaching and learning

theory. Other than that, I had no hands-on teaching experience. I learned the practice from observing my more experienced colleagues and performing the same techniques I experienced as a student in my prior education.

Much of the teaching involved case management and small seminar-style discussions in a face-to-face environment. My colleagues and I would give students the cases ahead of time and they would analyze and present their work in the seminar. This was still before the widespread use of computers in the classroom, so students received many handouts and submitted their work in handwritten form. The undergraduate courses I taught were traditional lectures. I noticed very early on that students were falling asleep in classes I used PowerPoint to lecture, which caused me to go back to distributing cases and showing very short videos. I would also do various student-centric, content-themed "games" and hands-on projects in class. I also regularly took continuing education courses to learn new teaching techniques I could repurpose for my own courses.

In the undergraduate program, the students were usually in the 18-24 age-range. However, the institution also had an accelerated version of the program with older students who had prior degrees in other fields. I found that there was a "social learning curve" with the traditional-age undergraduates. They had challenges in terms of maturity, such as skipping class, which caused me to have to grade them on attendance and participation.

I was excited about the changes happening to the demographic composition of the students. This was during the 1980's and 90's. In the past, nursing was almost exclusively a female dominated field, but I was seeing more male students. My particular institution had large populations of Hispanic students as well as many from Caribbean islands. My Haitian students faced a number of learning challenges due to a language barrier. Particularly with test questions, which isn't something they could design around because these students needed to pass a national certification exam in order to become nurses. They had trouble understanding what the exam questions were asking for. Nurses' passing certification exam scores are public information, thus the exam standards were a large part of it. I don't think we were as supportive as we could have been to these students. The university did have writing assistance services and students with disabilities were able to receive accommodations, such as extended test times, but in terms of helping ESL students through the language and communication barriers, there was no cohesive effort by the nursing faculty.

My Haitian students also ran into issues in clinical courses. A component of their program involves what was referred to as "professional comportment." Things such as nursing uniforms and the manner in which professionals conduct themselves. These norms came into increasing conflict by the early 2000's with more and more students expressing themselves through tattoos and body piercings, requiring those standards to adapt with the times in order to be able to

keep educating new nurses. The 2000's also ushered in some exciting new tools

for nursing education in the form of simulation labs. These are elaborate rooms

set up like hospital rooms, complete with beds and sophisticated human models

which can be programmed to exhibit a variety of medical conditions. The

simulated humans can be controlled and the students monitored by an instructor

from a control station adjacent to or in the lab.

Entrance Into Online Learning.

I actually took some online courses in genetics for my doctoral research in

prenatal ultrasound and identifying chromosome abnormalities before ever

teaching online myself. At the time, I wanted to develop a course in genetics and

also wanted to be able to offer an online option to her students. I pursued online

teaching on my own, not in response to my institution's strategic goals and

started small with a one-credit course. Instead of having long lectures, I used

various interactive tools and short videos from YouTube and TED talks. Like my

in-person teaching practice, I learned extensively by modeling the instructors in

the courses I enrolled in as a student.

My students who suffered from language barriers in an in-person

environment did much better online. I suspect the online format helped them

overcome the language barrier by allowing more time to think and formulate

responses. I feel that my ESL students were self-conscious about speaking English

in front of their peers. They were shy about asking for the meaning of a particular

word, or making the instructor repeat things. Online, these students were more

enthusiastic and worked twice as hard to accomplish their goals.

I enjoyed teaching online as an alternative to teaching face-to-face. My

courses were asynchronous, so my students could work on them as their personal

schedules allowed. I also found that it fit into my schedule better as well. I

managed to translate my case study assignments and lectures to an online format.

I also did an activity in both my undergraduate and graduate courses in which

students had to teach on a topic that I still use today. I even pick up a few

teaching techniques through her students' teaching projects every now and then.

I think I get more actual input from her students online than in the

classroom. Students are hesitant to say anything with thirty of their peers in the

room with them. They don't feel safe enough to potentially be wrong or don't

want to be challenged. But online, they have the opportunity to check their

knowledge beforehand and think about their responses. They feel more prepared.

Retelling and Reflection on Course B, the Nursing Course.

The Teaching Video Project has a technology barrier. I have no technical

resource to provide them that walks them through actually recording the video

and submitting it. This makes it difficult for them because they have to figure out

that part out on top of demonstrating their knowledge of the course content.

When I'm learning a new tool, I find it helpful to have step-by-step instructions

with screenshots and a short demonstration video. I feel something like that

would be helpful, but I don't have the time to do that on top of actually teaching

the course. What's more, because the students have to figure things out

themselves, I end up with a bunch of videos submitted in several different ways

that are difficult to grade because each student has accomplished the recording in

a different way.

In terms of their performance in giving the counseling session, half of my

students usually do a good job presenting the content to their "patient." They

present as if they are an active practitioner in that role. However, the other half of

her students appear to not know the content well enough to deliver it and explain

it naturally. They are supposed to synthesize the information in a way that is

understandable to someone with an 8th grade education level or lower. But

instead, they give raw technical information instead or don't provide visual aids,

or fail to employ positive therapeutic communication techniques. They don't

practice or review what they've done and think "Oh, maybe I should re-do this."

I think I post too many resources to the point where students disengage.

They'd rather go to Google and find some research article from 15-20 years ago

that was written in another country. This is a problem because research found

through google may not be current, or may be from a country with different

nursing standards than ours. I would much prefer that they use the university

library's scholarly search databases. Students in the program are introduced to

scholarly research at the beginning of the nursing program, but I don't specifically

review it in my courses.

Course B (Graduate Nursing) Modification Selection & Implementation (Learning

Designer Perspective)

In addition to the interviews, Kelly and I met for several work sessions to

narrow down the area of Course B we would apply UDL to. Prior to the first work

session, I examined the first Summer 2021 section of her course, and her syllabus.

I also reviewed the content of the second interview, which went in depth on her

responses to the Plus-One exercise in the selection survey. I proposed several

different areas based on her Plus-One and interview input, and ultimately, she

chose the Teaching Video Project for our focus. We examined her project through

the lens of UDL and I prepared a proposed list of modifications that would

address her concerns. Table 4.19 contains the abridged, final Course Modification

Proposal Kelly agreed to. The full version can be found in Appendix J.

Table 4.19

Abridged Course B Modification Proposal

Course B Modifications
Scope of Modifications: The Genetic Teaching Video Project will be modified with supports to better communicate expectations of the assignment and lower barriers presented by technology.
Parenthetical numbers reference applicable UDL Checkpoints
UDL Principle III. Multiple Means of Action & Expression (Strategic Network)
Modification B1: Provide detailed tech instructions and a well-defined, but optional pathway(s) for completing the project. **(4.2)**   **Modification B2:** Modify the pacing and scaffolding of the project by raising awareness of it earlier in the term and adding an extra, intermediary assignment toward the project which allows students to gain fluency with the technology before attempting the real thing. **(5.3)**   **Modification B3:** Increase prominence of the project's expectations with a more detailed description in the Syllabus, and putting the text of the instructions directly in Brightspace and linking to tech instructions, exemplar, and rubric frequently. **(6.1)**   **Modification B4:** Provide a detailed project instruction guide detailing each phase. **(6.2)**   **Modification B5:** Improve students' ability to monitor their progress by creating separate, more granular rubrics for each phase of the project and making these rubrics more visible and functional in the LMS. **(6.4)**
See Appendix I for the full version of this Course Modification Proposal.

About Course B's Teaching Video Project.

The Teaching Video Project is a summative assessment due at the end of

Course B's 7-week term. Student roleplay as a genetic counselor educating a

patient about a genetic condition and record the session on video to submit for

grading. Students choose their topic and also someone they know, such as a

classmate, family member, or friend, to play the role of their "patient." They

perform scholarly research on their chosen condition and then synthesize what

they learn about the condition so that it can be communicated to someone at an

8th grade education level. The project has several sub-assignments. including an

outline of what they plan to cover in their teaching video which is due one week

prior to the due date of the final video. They also submit a written reflection along

with it.

Kelly's concerns around this assignment are focused on two areas. First is

students' technical execution of the project. She provides them with some cursory

guidance on software to perform the actual recording, but mostly leaves students

on their own to find a way to record and submit the video. This leads to students

submitting videos in a variety of different formats, making it difficult for Kelly to

grade since she often has to do some technology troubleshooting in order just to

watch the videos.

Her second concern centers around the content of the videos submitted

by students. She feels that many students don't understand the expectations of

the project, or they rely too much on a script or notes during their session,

indicating that they either do not know the information about their condition

thoroughly, have not practiced beforehand, or have not integrated any

therapeutic communication techniques into their session. Looking at these

concerns through the lens of the UDL framework, they fall primarily within the domain of the Expression (Strategic) principle. Through our work sessions, we compared Kelly's implementation of the teaching video project in the control section with each of the UDL guidelines and we identified several opportunities for improvement. Each modification, the rationale for it, and its execution is described below. As with any UDL-guided modification, each item was reviewed in the context of the course objectives to ensure that it either did not interfere with them, or enabled them to achieve the objective in a variety of ways.

B1. Provide detailed technical video recording instructions.

To address Kelly's concern regarding the lack of technology guidance for her students to execute the assignment, I compiled a set of instructions using university-supported tools to record and submit the video project in a consistent manner. This would give students a fully fleshed-out "default" path supporting the technology use required in order to complete the assignment. The goal was to simplify this aspect of the project as much as possible to enable students to focus on the aspects of the project that are tied to the course's learning objectives. The steps in the written instructions included annotated screenshots to illustrate what students would see on their screens. To complement the written technology instructions, I also produced a video demonstrating the process. The default recording path asked students to use the Zoom web conferencing software's "cloud recording" to record a meeting with them and their "patient." Video

recorded in this manner is automatically sent to the university's video storage platform, Kaltura, and is available to embed from within the university's LMS. The last section of the instructions covered the steps to submit the video in the LMS as well. This modification is similar to Course A's video posting guide modification (A8). It corresponds to checkpoint 4.2, "Optimize access to tools and assistive technologies" which is under the guideline, "Provide options for Physical Action" at the "Access" level of the Action & Expression principle. As previously mentioned in the similar Course A modification, this checkpoint primarily refers to physical assistive devices and equipment, however it also emphasizes that it isn't enough to simply provide a new tool to students. Support also needs to be provided in order for learners to use the tool effectively (CAST, 2018; Meyer et al., 2014). This seemed to be the most appropriate checkpoint for this modification in spirit, if not in content. See Appendix F for an anonymized version of the recording instructions.

B2. Modify Pacing and Scaffolding.

Despite the fact that Course B is an accelerated seven-week course, students in the control sections did not have to submit any work toward the project until the video outline due in the sixth week. I proposed to Kelly that we expand the timeline of the project so that students must begin doing some work towards it much earlier in the term and it stays a priority in students' minds. To accommodate this, we added an item to the first week of the course requiring

students to simply review the project instructions, rubric, and other resources.

We also added an additional "phase" to the project due in the third week of the course. This extra sub-assignment of the project requires students to review the project instructions, the recording instructions (See modification B1) and record and submit a short practice video where they tell Kelly who will play the role of their "patient" for the final project video. The goal of this is to maintain awareness of the project through the term, give them a chance to perform a live technology test of their recording device, and acclimate them to the process of recording and submitting video-based assignments before having to do it for the high-stakes summative assessment. Both the project reminder in the first week and the additional practice video assignment align with UDL checkpoint 5.3, "Build fluencies with graduated levels of support for practice and performance," part of the "Provide Options for Expression & Communication" guideline at the "Build" tier of the Action & Expression principle (CAST, 2018; Meyer, Rose, & Gordon, 2014).

B3. Increase the prominence of the project expectations.

In a similar vein to B2, Kelly and I made an effort to ensure that students were exposed to materials communicating her expectations for the project as often as possible. Kelly had received permission from a former student to allow her to make it available to students as an exemplar of the quality she expected from them. In the control section, however, there was only a single link to this

video buried inside of a module folder. I included a link to this video with every

mention of the project in the course and in the project instructions. In addition,

Kelly and I added a more extensive summary of the project to her syllabus which

included hyperlinks to the full project instructions, video recording instructions,

and exemplar video. These modifications align with checkpoint 6.1," Guide

appropriate goal-setting" under the "Provide Options for Executive Functions"

guideline at the "Internalize" tier of the Action & Expression principle (CAST,

2018; Meyer et al., 2014).

B4. Provide a detailed project instruction guide detailing each phase.

In the control section, the video project's instructions were divided into

separate MS Word documents for the outline instructions and the project rubric.

Each of these files had to be downloaded and opened separately and were only

available starting during week 6. The instructions document itself was relatively

short and not sectioned to intuitively communicate that the project was separated

into a written outline, recording, and reflection components. It also provided no

recommended procedure to guide students through each phase. To reduce the

amount of effort required for students to access and parse this crucial

information, the various documents were consolidated into a single online Google

Doc. The new document opened with a brief overview of the entire project

summarizing each phase and when the deliverable for that phase was due, as well

as the grading rubric for each phase. From there, a section was added for each

phase of the project, including the new practice video phase of the project. Each

section contained detailed instructions and expectations. We also enhanced the

instructions document further by including frequent hyperlinks in the text to the

video recording instructions and exemplar video, and other sections of the

document wherever they were contextually relevant. To aid students in

navigating the document, I added a table of contents to the first page with in-

document hyperlinks allowing students to quickly jump to the section of

information they were seeking. This also enabled us to directly link to a specific

section of the document in the course. Consolidating all of the project information

into a single online document also made it possible for direct hyperlinks to be

added throughout the course. These modifications align with checkpoint 6.2,"

Support planning and strategy development" under the "Provide Options for

Executive Functions" guideline at the "Internalize" tier of the Action & Expression

principle (CAST, 2018; Meyer et al., 2014). An anonymized copy of this document

is available in Appendix D,

B5. Improve students' ability to monitor their progress.

Kelly had a rubric for the video project in the control section, but like the

original instructions, it was contained in an MS Word document and only available

in the week 6 folder of the course. It also did not communicate the importance of

various aspects of the project. Kelly and I discussed the rubric and she decided on

specific point values for various criteria based on their importance to the

objectives of the course. The project was also not taking advantage of the LMS'

rubric functionality. Therefore, in addition to having the revised rubrics in the new

instructions document, I implemented them in the LMS' "Rubrics" tool as well and

tied them to the submission page of each phase of the assignment. When

submitting a component of the project, the LMS would display the rubric on the

screen, offering them additional exposure to the Kelly's expectations for their

work. This also enhanced Kelly's grading capabilities, as she could now assign

points and feedback to specific criteria on her rubric for each students'

submission. After grading, students were able to see the specific areas they did

and did not achieve in regard to their work directly in the LMS. The original rubric

used in the control section can be found in Appendix G. The modified rubric is

part of the project instructions document in Appendix H. These modifications

align with checkpoint 6.4," Enhance capacity for monitoring progress" under the

"Provide Options for Executive Functions" guideline at the "Internalize" tier of the

Action & Expression principle (Meyer et al., 2014; CAST, 2018).

Course B Quantitative Student Data

Course B Demographics (BQ1 - BQ9).

The first part of the student survey was composed of demographic

questions in order to provide a sense of how similar the control and treatment

course sections were. In the case of Course B, both sections were very similar

with some notable exceptions. Table 4.20 contains the composition data for both

sections. Both sections contained an overwhelming majority of students

identifying as female. The major differences of note are that the treatment

section had more students in the 18-24 age range, was less ethnically and racially

diverse, contained no one willing to disclose a disability, and contained more

students also working full-time.

Table 4.20

Course B Student Demographics

Course B Student Demographics	Control	Treatment
Student Survey Participant Count	20	20
BQ1 - Age Group: Please indicate your age:		
18 - 24	40.00%	75.00%
25 - 31	25.00%	20.00%
32 - 38	20.00%	
46 - 52	5.00%	5.00%
39 - 45	10.00%	
BQ2 - Race and Ethnicity: How would you describe your race and/or ethnicity?		
White or Caucasian	70.00%	90.00%
Black or African American	15.00%	
Hispanic or Latino	5.00%	5.00%
Native American or Alaskan Native	5.00%	
I would prefer not to answer.	5.00%	
Asian or Pacific Islander		5.00%
BQ3 - Gender: How would you describe your gender?		
Female	85.00%	90.00%
Male	10.00%	10.00%
I would prefer not to answer.	5.00%	
BQ4 - Disability Status: How would you describe your physical and cognitive ability?		
I do not have a disability.	85.00%	100.00%
I would prefer not to answer.	5.00%	
I have a disability.	5.00%	
I have a cognitive disability.	5.00%	
BQ5 - DSC Accommodations: Which of the following describes you?		
I do not have a disability	85.00%	100.00%
I have reported my disability(ies) to the university Disability Services Office.	10.00%	
I would prefer not to answer.	5.00%	

Course B Student Demographics	Control	Treatment
BQ6 - Language Status: Is English your first language?		
Yes	80.00%	95.00%
No	15.00%	5.00%
I would prefer not to answer.	5.00%	
BQ7 - Employment: How would you describe your employment status?		
I am employed full-time.	35.00%	50.00%
I am employed part-time.	35.00%	40.00%
I am not employed.	30.00%	5.00%
I would prefer not to answer.		5.00%
BQ8 - Enrollment: How would you describe your enrollment status with the university?		
Full-time	95.00%	90.00%
Part-time	5.00%	10.00%
BQ9 - GPA Range: Which range does your current GPA fall into?		
3.5 - 4.0	65.00%	80.00%
3.0 - 3.49	35.00%	20.00%

Course B Student Survey - Quantitative Results (BQ10a, 11a, 12a & 13-16a).

Table 4.21 contains descriptive statistics for the Course B student survey quantitative questions. A full frequency table for the quantitative portion of the student survey can be found in Appendix A. Due to the ordinal and non-parametric nature of the data, the Mann-Whitney U test, shown in Table 4.22, was used to determine if there was a statistically significant difference between the means of student responses to questions across both sections of Course B.

Table 4.21

Course B Student Survey - Descriptive Statistics

#	Question	Section	N	Mean	SD	SE
BQ10a	(Affective) The teaching video project made me feel motivated to work on it.	Control	20	3.2	1.196	0.268
		Treatment	20	4	1.026	0.229
BQ11a	(Recognition) The teaching video project made me feel knowledgeable about course topics.	Control	20	4	1.747	0.391
		Treatment	20	4.8	0.951	0.213
BQ12a	(Strategic) The teaching video project gave me a clear sense of what the instructor expected from my work, and how to go about it.	Control	20	4.4	1.501	0.336
		Treatment	20	5.15	0.988	0.221
BQ13	I liked the teaching video project.	Control	20	3.2	1.361	0.304
		Treatment	20	3.9	1.165	0.261
BQ14	The teaching video project allowed me to effectively demonstrate my understanding and ability to apply course concepts.	Control	20	4.4	1.231	0.275
		Treatment	20	4.8	1.005	0.225
BQ15	The teaching video project appropriately measured my understanding and ability to apply course concepts.	Control	20	4.1	1.21	0.27
		Treatment	20	4.6	1.314	0.294
BQ16a	I felt the teaching video project is set up in a way that met my personal learning needs.	Control	20	3.6	1.353	0.303
		Treatment	20	4.5	1.235	0.276

Table 4.22

Course B Student Survey - Mann-Whitney U Test

#	Question	U	p	Rank-Biserial Correlation
	UDL Aligned Questions			
BQ10a	(Affective) The teaching video project made me feel motivated to work on it.	124	**0.034**	**0.38**
BQ11a	(Recognition) The teaching video project made me feel knowledgeable about course topics.	152.5	0.191	0.237
BQ12a	(Strategic) The teaching video project gave me a clear sense of what the instructor expected from my work, and how to go about it.	143.5	0.113	0.282
	Social Validity Questions			
BQ13	I liked the teaching video project.	148.5	0.154	0.258
BQ14	The teaching video project allowed me to effectively demonstrate my understanding and ability to apply course concepts.	166	0.347	0.17
BQ15	The teaching video project appropriately measured my understanding and ability to apply course concepts.	149	0.159	0.255
	Perceived Learning Needs Question			
BQ16a	I felt the teaching video project was set up in a way that met my personal learning needs.	124.5	**0.038**	**0.377**

Note: For the Mann-Whitney test, effect size is given by the rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."
*$p < .05$

Two questions produced statistically significant results. BQ10a, "The teaching video project made me feel motivated to work on it" exhibited a medium-positive effect ($U = 124$, $p = .034$, $r_{rb} = .38$). BQ16a, "I felt the teaching video project was set up in a way that met my personal learning needs" also exhibited a medium-positive effect ($U = 124.5$, $p = .038$, $r_{rb} = .377$). Rain cloud plots of the data for these two questions are shown below in Figures 4.15 and 1.16. Plots for the data from other questions may be found in Appendix E.

Figure 4.15

Rain cloud plot of BQ10a: Affective-aligned question
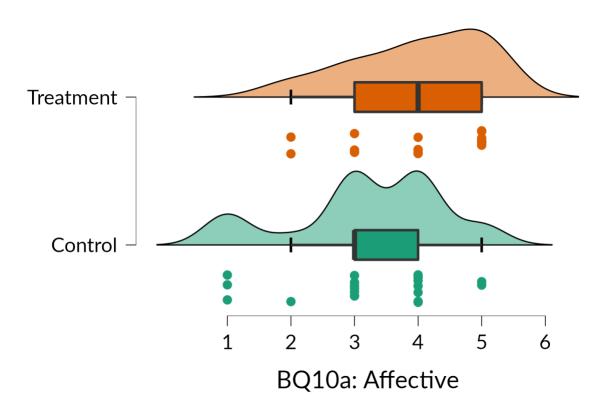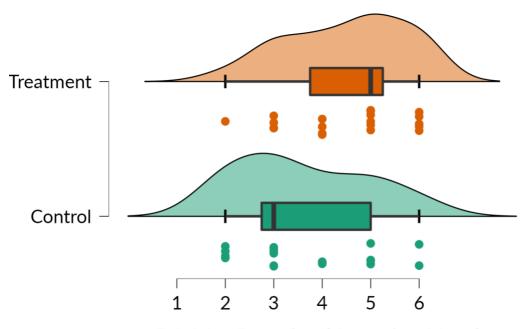
Figure 4.16

Rain cloud plot of BQ16a: Perceived Learning Needs

Course B Other Quantitative Results.

There was no statistically significant difference between students' project grades between the sections, as shown below in tables 4.23 and 4.24.

Table 4.23

Course B Teaching Video Project Grade - Descriptive Statistics

		Valid	Mean	Median	Std. Dev.	Min.	Max.
Project Grade	**Control**	26	95.375	98.375	10.548	46.5	100
	Treatment	28	98.727	99	1.376	93	100

Table 4.24

Course B Teaching Video Project Grade - Mann-Whitney U Test

	U	*p*	*Rank-Biserial Correlation*
Project Grade	279.5	0.145	-0.232

Note: For the Mann-Whitney test, effect size is given by the rank biserial correlation. An effect size of zero to ±0.39 is interpreted as a "small effect"; ±0.4 to ±0.59 is a "medium effect"; and greater than or equal to ±0.6 is a "large effect."
*p < .05

In addition to analyzing students' grades on the project in the two sections, I also performed an inventory of the different methods students used to produce and submit their teaching videos. Each method identified is defined in Table 4.25. Table 4.26 lists the percentage of use of each method in the control and treatment sections.

Table 4.25

Course B Recording Method Definitions

Video Submit Methods	Definition
Supported Recording Path	Student clearly used the recording path provided in the Treatment course evidenced by the video being in a Kaltura embedded video frame in the submission and its caption track being named "Zoom," signaling that it passed through Zoom's auto-captioning process before being passed to Kaltura.
Direct Upload	The whole video file was attached as a file in the assignment submission
Zoom Link	Student submitted a Zoom Cloud recording link to the assignment.
Video Note	Student recorded the video with Brightspace's Video Note feature.
Google Drive	Student uploaded the video file to Google Drive and provided a link in the assignment submission. Actual method to record the video unknown.
Kaltura	Student either uploaded the video file to Kaltura or recorded it using Kaltura's recording tool and provided a link to it in the assignment submission. May have gained some of the knowledge to do this from the treatment section's Recording Instructions.
YouTube	Student uploaded the video file to YouTube and provided a link in the assignment submission. Actual method to record the video unknown.
iCloud	Student uploaded the video file to Apple's iCloud and provided a link in the assignment submission. Actual method to record the video unknown.

Table 4.26

Course B Video Recording & Submission Methods

	Control		Treatment	
Video Submit Methods	*Count*	*Percent*	*Count*	*Percent*
Supported Recording Path	0	0%	**19**	**70.37%**
Direct Upload	**16**	**64%**	0	0%
Zoom Link	2	8%	2	7.41%
Video Note	4	16%	3	11.11%
Google Drive	1	4%	0	0%
Kaltura	1	4%	0	0%
YouTube	1	4%	2	7.41%
iCloud	0	0%	1	3.7%
Total	25	100%	27	100%

The control section had a large contingent of students (*n*=16, 64%) who uploaded the full video file directly to the course. You may recall this method was not desirable to the instructor, Kelly. This was one of the main factors which drove us to focusing on improving her implementation of the teaching video project. The treatment section, which included a detailed guide for recording and submitting the video using university-supported technologies, had no students submitting the video as a direct upload to the course. Instead, a large contingent (*n*=19, 70.37%) used the default recording and submission pathway documented in the recording instructions.

Finally, a few metrics were collected in the treatment section which had no comparable variable in the control section. These were collected only to provide

evidence that the materials created as part of modification of the teaching video were accessed by students. Figures 4.17 and 4.18 below show the access statistics of the Video Teaching Project instructions and Recording Instructions documents over the course duration of the treatment section's term.
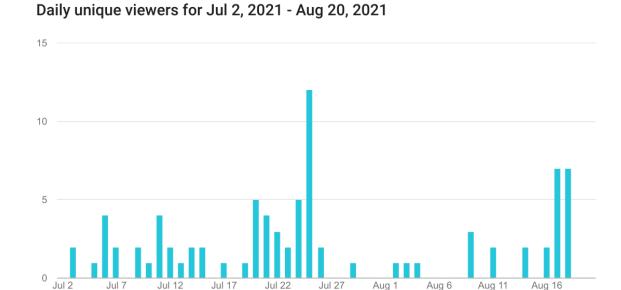
Figure 4.17

Student access to Teaching Video Instructions document

Daily unique viewers for Jul 2, 2021 - Aug 20, 2021

Figure 4.18

Student access to Recording Instructions document

Daily unique viewers for Jul 2, 2021 - Aug 20, 2021

Course B Qualitative Student Survey Results

The analysis of the qualitative portions of the Course B student survey

yielded 96 codable responses from the control section and 128 from the

treatment section. The three tables below provide specifics about the

instrumentation and general overviews of the results. Table 4.27 lists the open-

response qualitative questions from the Course B student survey that were used

to collect this date. Table 4.28 contains a high-level summary of the data using

the broad "Effect" code category which breaks down outcomes according to

whether they represent a positive/neutral outcome, or a negative one. A full

summary of the counts and percentages for all statement codes and categories

may be found in Appendix E. Table 4.29 gives a breakdown of course B's

students' qualitative statements organized by their UDL-aligned course element

and the UDL-aligned student outcome.

Table 4.27

Course B Student Survey Qualitative Response Questions

BQ10b.	What aspects of the teaching video project and its supporting materials helped, or didn't help your motivation to work on it?
BQ11b.	What aspects of the teaching video project and its supporting materials helped, or didn't help in understanding the topics in this course?
BQ12b.	Briefly describe your process for completing the teaching video project. In other words, what strategies did you employ, resources you used, etc.
BQ16b.	What aspects of the teaching video project made you feel this way?
BQ17.	Optional: Do you have any other feedback regarding the teaching video project you would like to share?

Table 4.28

Course B High-Level Qualitative Data Summary

| | Course B Section | | | |
| | Control | | Treatment | |
UDL-Aligned Effect Summary	*N*	*%*	*N*	*%*
Strategic Statement	38	39.58%	50	39.06%
Affective Statement	22	22.92%	32	25.00%
Recognition Statement	16	16.67%	28	21.88%
Negative Affective Statement	12	12.50%	13	10.16%
Negative Strategic Statement	5	5.21%	3	2.34%
Negative Recognition Statement	3	3.13%	2	1.56%
Totals	**96**		**128**	

Table 4.29

Course B Student Qualitative Data by Course Element

Course Element	UDL Outcome Alignment	Outcome Detail Code	Control		Treatment	
			N	%	N	%
Strategic-Aligned Course Elements						
Being On Camera	**Affective**	Disliked, Disengaged, Demotivated, Indifferent	7	7.29%	6	4.69%
Execution	**Strategic**	Organizing Information into Knowledge & Env. Restructuring			3	2.34%
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting	9	9.38%	2	1.56%
		Self-Instruction, Rehearsing/Memorizing & Imagery	3	3.13%	7	5.47%
	Affective	Self-Evaluation & Self-Consequences (Reflection)			1	0.78%
Exemplars	**Strategic**	Helped Understand Expectations	7	7.29%	6	4.69%
	Affective	Helped Engagement & Motivation			1	0.78%
Instructions	**Strategic**	Did Not Help Understand Expectations	1	1.04%	1	0.78%
		Helped Understand Expectations	2	2.08%	10	7.81%
		Unclear Expectations for Patient			1	0.78%
Non-Text Mode of	**Affective**	Covid Video Fatigue			2	1.56%
		Disliked, Disengaged, Demotivated, Indifferent	1	1.04%	2	1.56%

Course Element	UDL Outcome Alignment	Outcome Detail Code	Section			
			Control		Treatment	
			N	%	N	%
Expression		Helped Engagement & Motivation	2	2.08%	3	2.34%
		Self-Evaluation & Self-Consequences (Reflection)	2	2.08%		
	Recognition	Did Not Help Understand Topic or Concept	1	1.04%		
		Helped Understand Topic or Concept	4	4.17%		
	Strategic	Helped Demonstrate Knowledge	2	2.08%	1	0.78%
		Too Much Material To Cover In Video	1	1.04%		
Pacing & Scaffolding	**Strategic**	Help Seeking & Time Management			1	0.78%
		Helped Understand Expectations			3	2.34%
	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	1.04%	1	0.78%
		Helped Engagement & Motivation			2	1.56%
	Recognition	Helped Understand Topic or Concept			1	0.78%
Peer Instruction	**Recognition**	Helped Understand Topic or Concept	4	4.17%	14	10.94%
	Affective	Difficulty Interacting	1	1.04%		
		Helped Engagement & Motivation	2	2.08%	2	1.56%
		Self-Evaluation & Self-Consequences (Reflection)	1	1.04%	4	3.13%
Project Outline	**Strategic**	Helped Understand Expectations	2	2.08%	4	3.13%
		Organizing Information Into Knowledge & Env. Restructuring	2	2.08%	1	0.78%

Course Element	UDL Outcome Alignment	Outcome Detail Code	Control		Treatment	
			N	%	N	%
		Time Consuming	1	1.04%		
	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	1.04%		
		Helped Engagement & Motivation	5	5.21%	3	2.34%
		Self-Evaluation & Self-Consequences (Reflection)	1	1.04%		
	Recognition	Helped Understand Topic or Concept	1	1.04%	5	3.91%
Rubric	**Strategic**	Helped Understand Expectations	3	3.13%	1	0.78%
Scholarly Research	**Recognition**	Helped Understand Topic or Concept	7	7.29%	5	3.91%
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting	4	4.17%	3	2.34%
	Affective	Helped Engagement & Motivation	1	1.04%	3	2.34%
Technology Usage	**Strategic**	Successful Technical Execution	1	1.04%	1	0.78%
	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	1.04%	1	0.78%
Affective-Aligned Course Elements						
Career Relevance	**Affective**	Self-Evaluation & Self-Consequences (Reflection)	5	5.21%	2	1.56%
Choice of Patient	**Strategic**	Difficulty Finding	2	2.08%	1	0.78%
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting			1	0.78%
	Affective	Disliked, Disengaged, Demotivated, Indifferent			1	0.78%
Choice of Topic	**Affective**	Helped Engagement & Motivation	3	3.13%	7	5.47%
	Recognition	Helped Understand Topic or Concept			3	2.34%

Course Element	UDL Outcome Alignment	Outcome Detail Code	Section			
			Control		Treatment	
			N	%	N	%
Instructor Availability & Feedback		Limited Learning to One Disorder	1	1.04%	2	1.56%
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting			2	1.56%
	Affective	Helped Engagement & Motivation			3	2.34%
		Self-Evaluation & Self-Consequences (Reflection)			1	0.78%
	Strategic	Help Seeking & Time Management			2	1.56%
		Helped Understand Expectations	1	1.04%		
Recognition-Aligned Course Elements						
Course Texts & Videos	**Strategic**	Reviewing, Self-Monitoring, Task Strategies & Goal Setting	2	2.08%	2	1.56%
	Recognition	Insufficient Material in Course For Project	1	1.04%		
Totals			96		128	

Course B Control Section.

These results are illustrated below in Figure 4.19. Of the control section's

96 statements, 84.38% (n=81) pertained to a Strategic-aligned course element.

Two elements in particular received a lot of mention from students, each

receiving 13 (13.54%). These two elements include the "Project Outline"

component of the overall Teaching Video Project and the non-text mode of

expression used to assess students' comprehension of the course material. While

a large portion of the statements pertained to these two elements, the outcomes

students expressed related to those elements were numerous and dispirate. The

Project Outline's largest outcome contingent had 5 (5.21%) statements which

indicated that the outline helped their engagement and motivation to complete

the project (Affective-aligned outcome); "The outline/written teaching plan was

helpful in my motivation to work on and complete the project." Two students felt

that the project outline helped them better understand Kelly's expectations for

the teaching video project (Strategic-aligned outcome), and another two shared

details on how the outline aided their process which I emphasized with the

"Organizing information into Knowledge and Environmental Restructuring code";

"It helped me focus on what I want to say." These two outcome statement codes

are Strategic-aligned. One student noted that the outline helped them understand

concepts or topics (1.04%; Recognition-aligned outcome). Finally, two students

noted different negative outcomes, accounting for 1.04% of the statements each.

One found the outline too "time-consuming," (Strategic-aligned outcome) while the other expressed that, "the outline was the most challenging to get through." This particular statement was unique in its neutrality, and the lack of nuance gave few clues to its true intent. The student selected '4' in the likert question aligned with this response on the student survey which was on a scale of 6. Therefore, rather than create another statement code, I chose to include it in the "Disliked, Disengaged, Demotivated, Indifferent" category (Affective-aligned outcome).

As previously mentioned, students in the control section also had a lot to say about the visual, non-text-based nature of the project. The largest contingent (4, 4.17%) expressed that the project in general helped them understand the course concepts and topics. Specifically in most cases the concept or topic mentioned was the genetic condition they chose to focus on for the project. Two students felt that this aspect of the project enabled them to better express their knowledge; "I personally make videos online for fun, so to have an assignment that's based on video creation really paired well with my learning style." Two more felt that the non-text nature of the project helped their engagement and motivation. Three students each expressed different negative outcomes associated with the non-text nature of the project and with a different UDL network. The first simply expressed they "did not feel motivated to do it" (Affective-aligned). Another felt that they would have had the same amount of knowledge regardless of whether or not they did the teaching video (Recognition-

aligned). Finally, one student expressed that there were too many things to cover in the duration of the 15 minute video which made it difficult to have a "normal" conversation with their role-playing patient (Strategic-aligned).

The Strategic-aligned "Peer Instruction" course element had 8 (8.33%) statements associated with it which were mapped to four different outcomes. The largest (n=4, 4.17%) is Recognition-aligned. These students expressed that the Peer Instruction aspect of the project helped them understand course concepts and their own selected topic. The other three outcomes associated with this element are Affective-aligned. Two students felt that the peer interaction aspect of the project helped their engagement and motivation. One student provided a statement which was reflective in nature; "I am partially a tactical learner so I learn by doing things. I think the teaching video is a great way to practice talking with patients about conditions." Finally, one student indicated that they had difficulty interacting with their role-playing patient; "It was harder to prompt a question from my [role-playing patient] than anything. I think I may just redo it to ensure they asked the correct things instead of me interjecting my info in."

The other Strategic-aligned course elements were less nuanced. All 7 (7.29%) statements regarding the exemplar video Kelly included with the project materials indicated that it was helpful in communicating Kelly's expectations for the project to her students. The same for the Rubric (n=3, 3.13%). Two students

felt that the project instructions helped them understand Kelly's expectations,

however one student felt the opposite. Twelve (12.5%) students gave deliberate

descriptions of their process which fell into two strategic-aligned outcomes. The

largest contingent, coded as "Reviewing, Self-monitoring, Task Strategies & Goal-

Setting" generally described a process of researching their selected disorder,

writing the outline and recording the video (n=9, 9.38%). However, three (3.13%)

students disclosed a process which included deliberate practice before recording

their video, as represented by the "Self-Instruction, Rehearsing/Memorizing &

Imagery" code. Statements regarding the "Scholarly Research" course element

(n=12, 12.5%), primarily expressed that this act helped them understand a topic or

concept (n=7, 7.29%; Recognition-aligned outcome). Four (4.17%) provided some

insight into their research process (Strategic-aligned outcome); "...Then I went

through all of the different topics I needed to cover and researched using the

library databases and search engines." Two (2.08%) students mentioned the

technology use required for the project. One simply noted that the video was

"easy to film" and the other expressed using technology as a demotivating factor.

Similarly, one student was also demotivated by the demanding pace of the

project. However, the element contributing most to students' disengagement and

demotivation in this section is the Strategic-aligned "Being on Camera." Seven

(7.29%) of students expressed anxiety about recording themselves and being on

camera; "If I had a choice, I would have preferred to not complete the video

portion, or have an alternative as I am not one to always feel confident and comfortable in front of a camera, even if it's with a family member."

Statements regarding Affective-aligned course elements accounted for 12.5% (n=12) of the control section statements. All but one led to in-network, Affective-aligned outcomes. Five (5.29%) students provided statements which reflected on the career relevance and importance of this project (Affective-aligned outcome). Some students (n=3, 3.13%) felt that having the freedom to choose their own genetic disorder was a source of engagement and motivation for them. However one expressed disappointment at the fact they were only able to go in depth with a single disorder. Two (2.08%) students found it difficult to find a patient. One of these in particular noted, "It's hard to find someone [willing] to be your patient, especially living in a community where English isn't the first language." Finally, one student mentioned Kelly's feedback and interaction as being helpful in understanding the expectations of the project (Strategic-aligned outcome); "I looked at the feedback on my teaching plan and wrote down the questions I knew I needed to ask to make sure I covered [everything]."
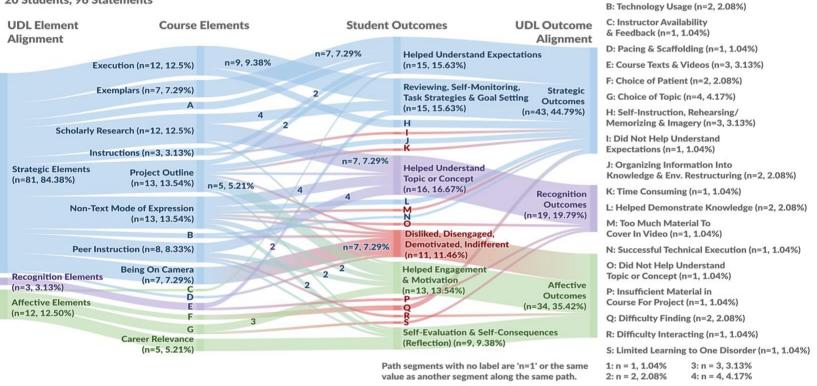
Statements tied to Recognition-aligned course elements accounted for only 3.13% (n=3) of the control section statements. All of which pertained to Course B's texts and videos. Two students noted them prominently in their task strategies for executing the project (Strategic-aligned outcome). A third student expressed that "only" one week's course content was beneficial to their project.

Figure 4.19

Course B Control Section - Overview by Course Element

Qualitative Student Data Overview by Course Element
20 Students, 96 Statements

UDL Element Alignment — Course Elements — Student Outcomes — UDL Outcome Alignment

A: Rubric (n=3, 3.13%)
B: Technology Usage (n=2, 2.08%)
C: Instructor Availability & Feedback (n=1, 1.04%)
D: Pacing & Scaffolding (n=1, 1.04%)
E: Course Texts & Videos (n=3, 3.13%)
F: Choice of Patient (n=2, 2.08%)
G: Choice of Topic (n=4, 4.17%)
H: Self-Instruction, Rehearsing/ Memorizing & Imagery (n=3, 3.13%)
I: Did Not Help Understand Expectations (n=1, 1.04%)
J: Organizing Information Into Knowledge & Env. Restructuring (n=2, 2.08%)
K: Time Consuming (n=1, 1.04%)
L: Helped Demonstrate Knowledge (n=2, 2.08%)
M: Too Much Material To Cover In Video (n=1, 1.04%)
N: Successful Technical Execution (n=1, 1.04%)
O: Did Not Help Understand Topic or Concept (n=1, 1.04%)
P: Insufficient Material in Course For Project (n=1, 1.04%)
Q: Difficulty Finding (n=2, 2.08%)
R: Difficulty Interacting (n=1, 1.04%)
S: Limited Learning to One Disorder (n=1, 1.04%)

UDL Element Alignment:
Strategic Elements (n=81, 84.38%)
Recognition Elements (n=3, 3.13%)
Affective Elements (n=12, 12.50%)

Course Elements:
Execution (n=12, 12.5%)
Exemplars (n=7, 7.29%)
Scholarly Research (n=12, 12.5%)
Instructions (n=3, 3.13%)
Project Outline (n=13, 13.54%)
Non-Text Mode of Expression (n=13, 13.54%)
Peer Instruction (n=8, 8.33%)
Being On Camera (n=7, 7.29%)
Career Relevance (n=5, 5.21%)

Student Outcomes:
Helped Understand Expectations (n=15, 15.63%)
Reviewing, Self-Monitoring, Task Strategies & Goal Setting (n=15, 15.63%)
Helped Understand Topic or Concept (n=16, 16.67%)
Disliked, Disengaged, Demotivated, Indifferent (n=11, 11.46%)
Helped Engagement & Motivation (n=13, 13.54%)
Self-Evaluation & Self-Consequences (Reflection) (n=9, 9.38%)

UDL Outcome Alignment:
Strategic Outcomes (n=43, 44.79%)
Recognition Outcomes (n=19, 19.79%)
Affective Outcomes (n=34, 35.42%)

Path segments with no label are 'n=1' or the same value as another segment along the same path.
1: n = 1, 1.04%   3: n = 3, 3.13%
2: n = 2, 2.08%   4: n = 4, 4.17%

Course B Treatment Section.

Of the treatment section's 128 codable statements, 110 (78.91%) were tied to a Strategic-aligned course element. All results for the treatment section are illustrated in Figure 4.21. Some noted differences from the control section are a smaller percentage of students who were disengaged by Being on Camera (n=6, 4.69%). There was a much larger contingent of students for whom Peer Instruction contributed to their understanding of course concepts, including their topic (n=14, 10.49%). There was also a large increase in the number of students who felt that the project instructions helped them understand the expectations of the project (n=12, 9.38%). The treatment section students also suggested an increase in the number of students practicing prior to recording (n=7, 5.47%). Fewer students described Scholarly Research (n=5, 3.91%) as helping them understand topics or concepts, and fewer mentioned the rubric specifically. Finally, two students expressed fatigue with video-based activities due to the amount of remote instruction due to the COVID-19 pandemic (1.56%).

Affective-aligned course elements accounted for 19.53% (n=25) of the treatment section statements. The "Choice of Topic" course element increased in prominence from the control section (n=14, 10.94%). 7 (5.47%) expressed that being allowed to choose their own topic helped their engagement and motivation; "I had a very good friend growing up who died of complications from CF and I would visit her a lot in the hospital and [get] to learn a lot about the disease. This

motivated me a ton to learn even more". Three students (2.34%) felt this choice

helped their understanding of course topics and concepts; "Picking a genetic

disorder was probably the hardest part of the project. However, it was nice to be

able to really dive deep into a particular genetic disorder and understand

everything about it." Finally, three (2.34%) students felt that Kelly's availability

and feedback contributed to their engagement and motivation; "I appreciated that

the teachers were so willing and quick at answering any questions that I had.".

Figure 4.20

Course B Treatment Section - Overview by Course Element

Course B Student Qualitative Results by Modification.

The coding for the 'Modification' category is very subjective. Particularly since many of the modifications are very closely related to one another. It is for this reason that I chose to report the entire qualitative results for the course sorted by Course Element first before moving to this even more interpretive categorization of the data. Table 4.30 found below, contains a summary of this data, and a visualization of the modification-specific data may be found in Figure 4.22 at the end of this section. Figure 4.22 was rendered with only data pertaining to the modifications to produce a much more succinct visualization compared to the full alluvials in previous sections.

Table 4.30

Course B Qualitative Summary by Modification

			Section			
			Control		Treatment	
Mod	UDL Outcome Alignment	Statement Detail	N	%	N	%
		Strategic-Aligned Course Elements				
B1	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	1.04%	1	0.78%
	Strategic	Successful Technical Execution	1	1.04%	1	0.78%
B2	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	1.04%	1	0.78%
		Helped Engagement & Motivation			3	2.34%
	Recognition	Helped Understand Topic or Concept			1	0.78%
	Strategic	Help Seeking & Time Management			1	0.78%
		Helped Understand Expectations			3	2.34%
B3	Affective	Helped Engagement & Motivation			1	0.78%
	Strategic	Helped Understand Expectations	7	7.29%	6	4.69%
B4	Strategic	Did Not Help Understand Expectations	1	1.04%	1	0.78%
		Helped Understand Expectations	2	2.08%	10	7.81%
		Unclear Expectations for Patient			1	0.78%
B5	Strategic	Helped Understand Expectations	3	3.13%	1	0.78%

Mod	UDL Outcome Alignment	Statement Detail	Control		Treatment	
			N	%	N	%
UM	Affective	Covid Video Fatigue			2	1.56%
		Difficulty Interacting	1	1.04%		
		Disliked, Disengaged, Demotivated, Indifferent	9	9.38%	8	6.25%
		Helped Engagement & Motivation	10	10.42%	10	7.81%
		Self-Evaluation & Self-Consequences (Reflection)	4	4.17%	5	3.91%
	Recognition	Did Not Help Understand Topic or Concept	1	1.04%		
		Helped Understand Topic or Concept	16	16.67%	24	18.75%
	Strategic	Helped Demonstrate Knowledge	2	2.08%	1	0.78%
		Helped Understand Expectations	2	2.08%	4	3.13%
		Organizing Information Into Knowledge & Env. Restructuring	2	2.08%	4	3.13%
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting	13	13.54%	5	3.91%
		Self-Instruction, Rehearsing/Memorizing & Imagery	3	3.13%	7	5.47%
		Time Consuming	1	1.04%		
		Too Much Material To Cover In Video	1	1.04%		
Affective-Aligned Course Elements						
UM	Affective	Disliked, Disengaged, Demotivated, Indifferent			1	0.78%

Mod	UDL Outcome Alignment	Statement Detail	Section			
			Control		Treatment	
			N	%	N	%
		Helped Engagement & Motivation	3	3.13%	10	7.81%
		Self-Evaluation & Self-Consequences (Reflection)	5	5.21%	3	2.34%
	Recognition	Helped Understand Topic or Concept			3	2.34%
		Limited Learning to One Disorder	1	1.04%	2	1.56%
	Strategic	Difficulty Finding	2	2.08%	1	0.78%
		Help Seeking & Time Management			2	1.56%
		Helped Understand Expectations	1	1.04%		
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting			3	2.34%
Recognition-Aligned Course Elements						
UM	**Recognition**	Insufficient Material in Course For Project	1	1.04%		
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting	2	2.08%	2	1.56%

UM = Unmodified. These are statements which referred to a course element that was not modified for this study.

Modification B1 Results.

B1's modification involved the addition of producing a default set of

technical instructions to support students in the production of their video

projects. There were few statements in the qualitative data which could be

directly attributed to this modification. This strategically-aligned modification had

one Affective-aligned statement in each section where disengagement and

demotivation due to technology was expressed. Each section also had one

statement in each where students simply mentioned that they were able to

successfully perform the recording.

Modification B2 Results.

B2 modifications centered around the pacing and scaffolding of the

teaching video project. Kelly and I added a review prompt to the first week and a

practice assignment in the third term to raise students' awareness and maintain its

presence in students' minds. These efforts induced an increase of the number of

statements attributable to this modification. The treatment section had nine

(7.03%) statements compared to the control section's single statement (1.04%).

This statement and its counterpart in the treatment section expressed dislike

relating to the pacing of the project. Three students (2.34%) in the treatment

section felt that the pacing and scaffolding of the project helped their

engagement and motivation (Affective-aligned outcome), and another three

students indicated that the pacing and scaffolding helped their understanding of

the project expectations (Strategic-aligned outcome). The treatment section had a single student indicate the pacing and scaffolding helped them understand course concepts and topics, and one student disclosed their process for completing the project for which the pacing of the project enabled.

Modification B3 Results.

B3 involved increasing the prominence of the strategic support materials surrounding the teaching video project, such increasing the frequency of mentions and links of the project instructions, rubrics and student exemplar video. The control section contained 7 (7.29%) statements aligned to this modification, all of which expressed the Affective-aligned outcome of helping students understand the expectations of the project. In the treatment section, this contingent was slightly smaller (n=6, 4.69%) and there was an additional student who provided a statement which indicated the prominence of the expectations helped their engagement and motivation.

Modification B4 Results.

B4 involved the creation of a detailed project instruction guide detailing each phase of the project and unified all of the expectations and directions for this multi-phase project in a single, organized, online document with convenient anchor hyperlinks for navigating through the document in a non-linear manner. In the treatment section, one student expressed that the instructions did not help them understand the expectations. Two students (2.08%) indicated that the

instructions helped them understand the expectations for the project. In the

treatment section, this contingent grew to 10 students (7.81%). The treatment

section also had a single student who felt the instructions did not help them

understand the project expectations. Finally, one student felt that not enough

guidance was provided in how to prepare their role-playing patient. I felt this was

good, warranted feedback and wanted to preserve it through it having its own

code.
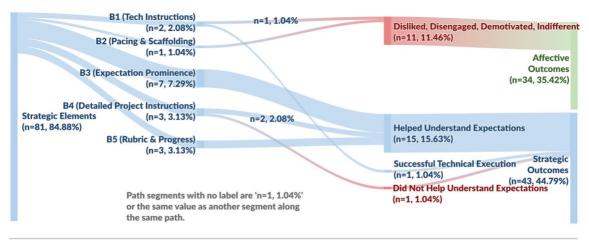
Modification B5 Results.
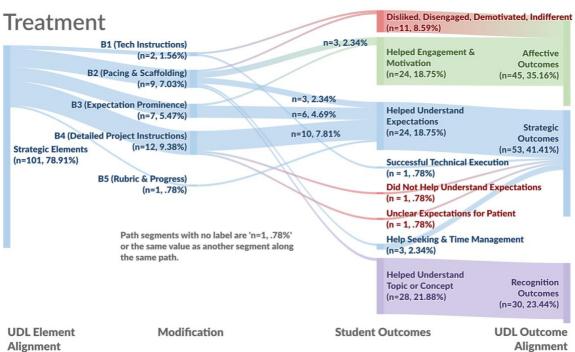
B5 pertained to improving students' ability to monitor their own progress.

This was done by improving the granularity of Kelly's rubrics and leveraging the

LMS' rubrics functionality to make them a prominent fixture in the course. The

control section yielded three (3.13%) statements indicating that this set of

modifications helped students understand the expectations of the project. This

contingent was reduced to one statement in the treatment section.

Figure 4.21

Course B Modification Effects - Strategic Course Elements

Control

B1 (Tech Instructions)
(n=2, 2.08%)

B2 (Pacing & Scaffolding)
(n=1, 1.04%)

B3 (Expectation Prominence)
(n=7, 7.29%)

B4 (Detailed Project Instructions)
(n=3, 3.13%)

Strategic Elements
(n=81, 84.88%)

B5 (Rubric & Progress)
(n=3, 3.13%)

n=1, 1.04%

n=2, 2.08%

Disliked, Disengaged, Demotivated, Indifferent
(n=11, 11.46%)

Affective Outcomes
(n=34, 35.42%)

Helped Understand Expectations
(n=15, 15.63%)

Successful Technical Execution
(n=1, 1.04%)

Strategic Outcomes
(n=43, 44.79%)

Did Not Help Understand Expectations
(n=1, 1.04%)

Path segments with no label are 'n=1, 1.04%' or the same value as another segment along the same path.

Treatment

B1 (Tech Instructions)
(n=2, 1.56%)

B2 (Pacing & Scaffolding)
(n=9, 7.03%)

B3 (Expectation Prominence)
(n=7, 5.47%)

B4 (Detailed Project Instructions)
(n=12, 9.38%)

Strategic Elements
(n=101, 78.91%)

B5 (Rubric & Progress)
(n=1, .78%)

n=3, 2.34%

n=3, 2.34%

n=6, 4.69%

n=10, 7.81%

Disliked, Disengaged, Demotivated, Indifferent
(n=11, 8.59%)

Helped Engagement & Motivation
(n=24, 18.75%)

Affective Outcomes
(n=45, 35.16%)

Helped Understand Expectations
(n=24, 18.75%)

Strategic Outcomes
(n=53, 41.41%)

Successful Technical Execution
(n = 1, .78%)

Did Not Help Understand Expectations
(n = 1, .78%)

Unclear Expectations for Patient
(n = 1, .78%)

Help Seeking & Time Management
(n=3, 2.34%)

Helped Understand Topic or Concept
(n=28, 21.88%)

Recognition Outcomes
(n=30, 23.44%)

Path segments with no label are 'n=1, .78%' or the same value as another segment along the same path.

| UDL Element Alignment | Modification | Student Outcomes | UDL Outcome Alignment |

Final Interview - Post Treatment (From Kelly's Perspective)

Impression of the Teaching Video Project Modifications.

I thought that the second section went really well in terms of grading the videos. With most of the students following recording instructions, it made it much easier to grade and provide feedback within the LMS, instead of having to download videos or figure out how to open them. The practice video assignment also helped many of them. I also used the feedback on the practice video as an opportunity to proactively encourage students to use the recording instructions. They also really found the demonstration video we posted helpful. It makes me think I should do the same for all of my assignments, but I'm concerned about how much work that would be.

In reading the comments, there was certainly a population that didn't see any value in the assignments, while others did. I also saw that several students were fearful of the video and they weren't comfortable with being on camera or teaching content. Others said picking a role playing "patient" was a problem for them and they wished they had done it with another student-- That option was available to them, but they didn't take advantage of it! I saw a few use a peer as their "patient." The value in choosing a fellow student is that they can learn from each other in terms of presenting the content. That's a learning opportunity. Where this is an asynchronous course, I'm not sure if that's a burden on them to use another student, though.

Fewer students read from a script word for word. I tried to emphasize, "Select a topic that you would feel comfortable in delivering. Don't pick a complex disorder," but they still do. I don't know if it's anxiety with videotaping or just not feeling comfortable or not willing to practice a couple times before they do it. One strategy I've employed to help students present more naturally is to emphasize that they use a visual aid during their recording session. It makes it easier for them to not rely on a script. Unfortunately, some students did not incorporate one. Visual aids are mentioned as something to include in the project, but I haven't explicitly required it. I also need to provide students some guidance for using visual aids effectively. Some students who did use visual aids would wait until the very end of their presentation to introduce the aid, which defeats its purpose. It isn't just an aid for the patient to understand the condition. It's also an aid for the student presenting to help them explain the condition. I'm thinking of making it a requirement in the future.

I wish we had scaffolded the project even more. I would have liked to incorporate more assignments requiring them to teach at the patient's education level along the way to help prepare them for the final video project. I did have some, but they were written and I could see value in them recording a video of how they would present that to a patient. I'd also like to have more self-critique of their work as well. They should be evaluating, "would this be a successful way of presenting this content to that patient? What would you do differently?"

Another thing I would change would be the grading rubric. It still wasn't granular enough in regard to the video's properties. All in all, though, I feel that the treatment section students were more prepared and delivered the teaching session as if they were in a real situation where they wouldn't be reading from notes or a script. The recording instructions also made students' execution of the project much smoother.

Impressions of UDL and the Modification Process.

This process gave me a new lens to look at how students learn and how they need clear instructions. They need different types of visuals and examples for them to move forward. I think we made progress toward achieving our original goal. In terms of preparing the students to do that project and its phases.

I see UDL as an important teaching and learning strategy. On my part, to make it easy for students to understand, to look at different ways that they can approach course work. You can incorporate short videos to compliment written instructions. The concept of beginning with an easier assignment and then advancing can be applied to all the courses I teach. I was recently in a meeting and we were talking about UDL today, and I was working with a student teacher and we approached the course content in terms of students learning. Furthermore, I'm considering how to introduce UDL to my students as a way of helping them learn how to communicate medical information to patients.

Discussion

Course A Summative Analysis

Course A is a fourteen-week, asynchronous online, intermediate undergraduate course in the institution's Engineering bachelor's program. The course covers economic and ethical issues related to the engineering field. Its instructor, David, has a vision for this course's discussions that is a product of what he values from his own, personal academic experience. In the 1950's, David was a first-generation undergraduate who did not receive the residential, 18–24-year-old college experience. He and his twin brother commuted back and forth to campus. As a result, he feels it took him longer to develop socially than his peers. The isolating nature of the field of engineering only made him feel this more keenly. While he feels that doing the same curriculum online would have given him the same academic preparation for the field, he feels his social situation would have been made even worse. As a result, he places great value on constructive dialogue between colleagues and developing this in his students is an important goal for him.

However, David's desire to spur dialogue among his students is a means to his true pedagogical end: To instigate more reflection. Reflection is a central theme throughout David's narrative. It's foundational in his experience as a student, as a professional practicing in his field, and in his desire to instigate more reflection in his students as one of his pedagogical goals. In his formative

education background, he was exposed to mentors who challenged him to think

beyond the confines of his field. He places a high value on the act of reflection as

a means for students to understand the role and responsibilities of engineers in

our society. He wants to elevate his students' view of themselves beyond the

insular sphere of "the geek in front of a computer terminal," as he puts it, and

guide them to acknowledge that their choices as engineers have consequences

for their fellow humans. In addition to relying upon discussion, he also exposes his

students to content outside the field of engineering that has bearing on

engineering and ethics. Such as his use of the play "All My Sons" as the backdrop

for ethical discussion. He has also invited colleagues in the field of philosophy to

speak to his students on the origins of ethics, because he recognizes what he is

not an expert in. His own personal appreciation of and undergraduate experience

with the humanities is the source of these pedagogical choices. He sees exposure

to the humanities as a way to deviate from the core black-and-white nature of his

field and as an entry point into the metacognitive exercise he values most,

reflection. The crux of David's techniques for getting his students to reflect is

their introverted nature. It pushes against the discussion aspect of his strategy.

He has a number of ways to mitigate this in the in-person version of his course,

but the asynchronous online version is what brought him to me.

David felt that his online discussions lacked depth and students were not

producing the deep responses and collegial conversations he wanted them to

have. Together, David and I used the UDL framework and guidelines to

brainstorm and implement the modifications detailed earlier in this chapter. We

attempted to recruit students' interest beyond the text-based discussion prompts

through the use of a brief, informal introductory video. We enhanced the

authenticity of the discussion prompts themselves by altering their wording to

make them less binary and more open-ended. Some modifications, such as A5,

gave students more options beyond text in how to express themselves. Others

were more involuntary, such as A3 which changed the discussion rubric to include

a social/collegial dialogue component and required students to reply to any

students who replied to their initial posting.

Albeit the small sample sizes, considering the quantitative data alone gives

the impression that our modifications had none or negative impact on students.

The quantitative portion of the student survey indicates that the modifications

may have caused students to dislike the discussion assignments more than the

original versions in the control section. It is also possible students in the treatment

section had a lowered perception that the discussions allowed them to effectively

demonstrate their understanding and ability to apply course concepts. There was

no statistically significant difference between the discussion grades in the course,

nor was there a statistically significant difference between the average initial post

word counts between the two sections. There was a positive, statistically

significant relationship in the number of replies-per-thread, however a look at the

means for each section, .848 for control and 1 for treatment, essentially means that in the control section, most students received one or no reply to their initial post, while in the treatment section most students received a single reply. Which is not the deep, collegial dialogue we were attempting to produce. Finally, Initial Poster Replies yielded a very statistically significant, high-positive result. While encouraging, this variable was tied directly to the requirement we added to the treatment section that students reply to any students who replied to their initial posting. Essentially, all this result really means is that students in the treatment course successfully followed directions, but still did the bare-minimum required of them like the students in the control section.

The qualitative data both contradicts and reinforces the quantitative results in several areas. The treatment section saw an increase in the percentage of statements indicating negative Affective and Recognition aligned outcomes, as well as a reduction in the percentage of students who expressed that some aspect of the discussions helped their motivation and engagement (see Table 27). Most of these statements are sourced from the "Topics for Discussion" Affective-aligned course element. Filtering the qualitative data by modification reveals that the alteration of the discussion questions (A1) seemed to contribute most to those negative Affective-aligned outcomes, as well as those of negative Recognition. Furthermore, the treatment section had two statements mentioning that the discussion expectations were too demanding. As stated previously, while
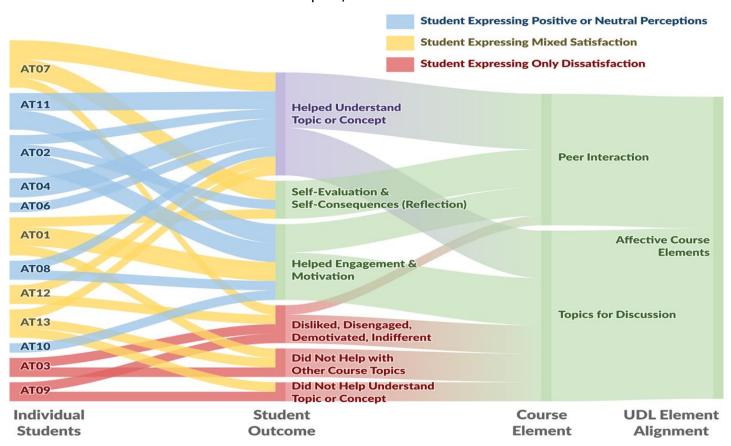
I feel that the "Modification" category makes it possible to better isolate the results of specific interventions in a course, the classification of student statements to various modifications is very subjective. Here is an example of such a statement: "I'm not sure I learned anything extra from the discussion. " It is difficult to determine if this student was referring to the actual discussion question or simply using the word 'discussion' to encapsulate the entire experience. For all we know, they could have actually meant the peer interaction element of the discussion assignments.

Barring the small sample sizes involved, the similarity between these and the quantitative results lends more weight to the possibility the Course A modifications had some negative impact on students in the treatment section. However, there are some strong observations in the qualitative data that were not represented in the quantitative results. The treatment section had two new contingents of statements that were not present in the control section. Both pertained to the Affective-aligned Peer Interaction element. The first and largest contingent (n=7, 10.77%) indicated that Peer Interaction helped them better understand course topics and concepts. The second, (n=4, 6.15%) expressed statements which indicated that Peer Interaction in the discussions induced further reflection and self-evaluation. There was also an increase in the number of statements claiming the Topics for Discussion helped them better understand course concepts (from 2.63% to 7.69%). When sorting the data by modification,

these patterns are attributed to the A1 (altering of discussion prompts) and A3

(addition of the "circle-back" requirement) modification sets. This suggests that

there were two "types" of students in the treatment section: Those for whom the

Affective-aligned modifications had a beneficial effect, and those who felt

antagonized by them. As I processed the data, I gave each student an anonymized

identifier that was recorded along with each statement. This enabled the

generation of the chart shown below in Figure 4.23 which shows only the

statements pertaining to the Peer Interaction and Topics for Discussion elements,

but sorts the data first by the student identifier from which they originated, then

by the statement detail code, followed by the course element.

Figure 4.22

Course A Treatment: Student Sentiment on Topics for Discussion & Peer Interaction

This visualization reveals a more complex relationship than I initially suspected. The treatment section had students who fell into three categories. The largest were those who expressed only positive or neutral perceptions in regard to the Topics for Discussion or Peer Interaction elements of the discussion assignments (n=6). Then there are those who expressed mixed perceptions (n=4), and finally those who only expressed some form of dissatisfaction (n=2). This chart also highlights that the Topics for Discussion were the main source of dissatisfaction, while the Peer Interaction element only had one statement expressing dissatisfaction with it. The control section's version of this chart is less compelling, with the students divided into two categories. No students had mixed outcome statements. Two had only negative statements and seven had only positive or neutral statements.

David seemed pleased with the results he saw in the discussions. He noticed more reflection happening in his student posts, though he is not sure if his students feel that the discussion assignments are worthwhile, which was an opinion he expressed before the qualitative results were available. I feel confident in expressing that most of his students, regardless of section, felt the discussions were worthwhile. Despite the negative effects suggested by the quantitative survey analysis, the qualitative data suggest while some students experienced primarily negative Affective-aligned effects from the modifications, more students found that the being required to respond to students replying to their initial posts

increased their understanding of the course content, and caused them to reflect more on the perspectives of their peers. What perplexes me, however, is that while a few students complained about the text-based mode of expression, why did no one take advantage of their ability to post video instead of text? Given the amount of visibility we gave that option by repeating it in every discussion prompt, I very much doubt students were unaware of it. As both of these course sections ran during a period of mass remote instruction during the Covid-19 pandemic, I wonder if some fatigue toward being on camera is at play.

Course B Summative Analysis

Course B is a seven-week, asynchronous online graduate course in the institution's Nursing master's program. The course covers core genetics concepts and conditions stemming from abnormalities in the human genome. The instructor, Kelly, sees the teaching video project as an important tool to assess students, as well as an authentic exercise to prepare students for the field. As a student and professional in her field, two major themes dominated Kelly's personal history. The first is the importance she places on the Strategic-aligned elements of the environments she's been a student in. Kelly requires an overarching goal, the ability to see how she is progressing towards that goal, and clear expectations in order to feel confident as a learner. She did not have these Strategic-aligned elements as a high school student, which led to undesirable Affective-aligned outcomes, such as anxiety and uncertainty. However, as she

progressed to higher levels of education, the more deliberate, design-driven nature of her nursing undergraduate and graduate coursework gave her structure and a sense of what was expected of her. The second theme reflected in Kelly's personal education history is the importance of hands-on, authentic learning. As a student, traditional lecture classroom pedagogy does little to ease her sense of preparedness and direction. It's only when she has the opportunity to learn in a clinical setting that she begins to see herself in the professional role that she's chosen and feel confident. Her affinity to experiential learning extends to her teaching as well. She seeks new professional development opportunities not just for the content itself, but to also pick up new teaching techniques from those whom she is learning from. She's even collected some from her students' teaching video projects. The teaching video project represents all of these elements that Kelly herself values as a learner. Students have the opportunity to practice skills which they will use as professionals in a simulated workplace situation. They seek scholarly sources to increase their knowledge of the disorder they've chosen, distill that information into an easier to understand form, and produce an artifact they can review to self-evaluate and assess where they are versus where they would like to be.

However, Kelly feels that the Teaching Video Project has two significant problems. The first is technical in nature. She does not have any resources to provide students on how to record and submit the video, which leads to students

coming to her for technology assistance, videos submitted in multiple formats or locations that make the process of grading them longer and inconsistent. The second problem relates to the quality of videos themselves in terms of how they align to the course objectives and Kelly's expectations. Students are supposed to collect information on a genetic condition of their choice from scholarly literature, synthesize it into a form comprehensible to a person with an 8th grade education level, and record a role-played genetic counseling session with someone they know playing the role of their patient. Kelly has found that too many of her students have skipped the effort to synthesize the information and instead recite raw medical jargon from their notes while their "patient" listens; neglecting to use any visual aids or therapeutic communication techniques. She also suspects few of her students attempt multiple "takes" of their video, or perform any practice beforehand.

Together, Kelly and I developed a series of modifications to the teaching video to address her concerns. Modification B1 established a default "path" for completing the technology steps relating to recording and submitting the video. The intention being to relieve students of the cognitive burden involved in figuring this out on their own. We documented this path in an illustrated, step-by-step guide which also included a companion video demonstrating all of the steps in the text-based guide. Knowing how to use video recording technologies was not part of the course objectives, therefore it was important to ensure that

students were spending as little effort as possible "fiddling" when they could be focused on the content and execution of the teaching session itself. The B2 modifications focused on the project's pacing and scaffolding. We increased the timeframe and added an additional scaffolded step in the project to give students more practice with the technology prior to recording and to increase their awareness of the project earlier in the semester, through earlier prompts to review the project's support resources. B3 pertained to the prominence of the project support resources. It included enhancing Kelly's course syllabus with a more detailed, but concise description of the project with hyperlinks to all of the project's resources. B4 modifications focused on the communication of Kelly's expectations. We produced a Project Instructions document which contained detailed instructions for each phase of the project, the rubrics, and frequent hyperlinks to the Recording Instructions document and the exemplar teaching video. We also modified every mention of the project in the course to include a hyperlink to the instructions document. Finally, B5 focused on students' ability to monitor their own progress. Each phase of the project was given its own assignment for students to submit their work to and we integrated the rubrics and links as functional and interactive components in those LMS assignment links and pages. The UDL alignment of all of these modifications fell into various guidelines and checkpoints of the Strategic domain of the UDL framework. See the section "*Course B Modification Selection & Implementation*" for full details.

The Quantitative results from the student survey, as well as both categorical analyses of the qualitative student data indicate that the modifications made to Course B's Teaching Video Project in the treatment section likely had a positive effect on Affective and perhaps to a lesser extent, the Strategic-aligned student outcomes. Question BQ10a, which was the Affective-aligned questions, yielded a medium-positive effect (U = 124, p = .034, r_{rb} = .38). B16, the "perceived learning needs" question, also yielded a medium-positive effect (U = 124.5, p = .038, r_{rb} = .377). While this question was originally meant to be interpreted separately outside of the scope of UDL. The text of the question, "I felt the teaching video project was set up in a way that met my personal learning needs," involves subjective exposition of an emotional state, thus if this study's coding guidelines are applied to the question, it would align to the Affective network. This interpretation is strengthened by the fact that the quantitative results of BQ16a and the intended Affective-aligned question, BQ10a are very similar.

Qualitatively, things are more nuanced. Looking simply at all of the statement outcome summary data, as I did in Table 4.28's Course B High-Level Qualitative Data Summary, it looks like Strategic outcomes were relatively unaffected, Recognition, and to a lesser degree, Affective outcomes improved. There were also fewer (percentage-wise) negative statements in the treatment section. Unfortunately, this high-level view does not tell us what the students were talking about that produced these outcomes. If the data are further refined

by sorting it by the course element statements and the student outcomes those statements expressed, it appears that the treatment section's project instructions helped students understand the project's expectations much more. (2.06% vs 7.81%).

One major difference between Course B's sections is the role of the Affective-aligned element, Peer Instruction. The treatment section had a much larger contingent of students who felt that the Peer Instruction helped them understand course concepts (4.17% versus 10.94%). However, this was a pre-existing aspect of the course that was not part of the modifications made in the treatment section. There are a number of possible explanations for this. It could have been researcher bias in my coding process, significant differences in personal factors between the student groups that was not revealed by the demographic data, or, optimistically, an indirect effect caused by the strategic supports added by the modifications and expanded timeline which might have reduced student uncertainty and anxiety, causing them to focus more on the content and process of preparing the video.

Filtering the qualitative data using the Modification data excludes statements which have to do with an origin course element that was not modified in the treatment section, and thus removing some potential "noise" from the data. Doing so shows that the effect of the new instructions document (B4) is still apparent as it is in the data when organized by the Course Element category. The

Pacing and Scaffolding changes (B2) appear to contribute evenly to helping students' engagement and motivation, as well as their understanding of the project's expectations. While neither the qualitative or Quantitative data show the recording instructions (B1) as having much or an impact, students did definitely access them and use them. However, I can only say for certainty that Kelly benefitted from them as she noted that her grading workflow was greatly simplified as a result.

Kelly seemed pleased by her observations over the course of the treatment section's term, but believes that more needs to be done. Her sentiment mirrors my own; that we didn't change enough to have the kind of effect she was looking for. That's not to say we did not have an impact. While not reflected in the quantitative data, based on the qualitative data, I feel confident in claiming that the revamped project instructions document (B4) and the pacing and scaffolding changes to the course (B2) led to positive strategic-aligned outcomes in the treatment section. In fact, the interrelation between many of the modifications means they all probably helped. As for the Affective-aligned outcomes observed in both the quantitative and qualitative data, despite being statistically significant, there really isn't any direct evidence that the modifications are responsible for them.

Chapter 5: Findings, Implications, Practices & Policies

Universal Design for Learning (UDL) is a framework based on peer-reviewed research and experience in cognitive neuroscience and education psychology. It was created to empower educators to provide students with learning environments that allow them to receive information, express their knowledge, and become engaged with their learning in ways that meet their diverse abilities, needs, backgrounds, and preferences (CAST, 2011). UDL's summative goal is to enable students to become expert learners (CAST, 2011). Despite its scientific underpinnings, UDL's authors themselves admit the UDL framework itself must be validated by research. (Meyer, Rose & Gordon, 2014). This is further emphasized by numerous scholarly studies and literature reviews. Specifically, this study identifies five themes in the existing literature to address as the body of UDL research continues to mature. The first three are observed by multiple authors, and the last two of my own observations.

1. The need for more empirical research on UDL's effect on student outcomes (Basham et al, 2010; Davies et al., 2013; Izzo et al., 2008; Kennedy et al., 2014; Seok et al., 2018; Spooner, 2007; Westine et al. 2019).

2. The lack of research which incorporates experimental comparison with control and treatment groups (Basham et al, 2010; Davies et al., 2013; Izzo et al., 2008; Kennedy et al., 2014; Seok et al., 2018).

3. The need to be clear and specific regarding the alignment of researchers' interventions that apply UDL and to test specific parts of the framework, rather than treat it as a single entity (Crevecoeur et al., 2014; Ok et al., 2017; Rao, 2014; Saifon, 2021).

4. There is an absence of in-depth phenomenological, qualitative exploration of the instructors' experiences learning about and applying UDL's principles.

5. There is also an absence of published studies which explore or evaluate a model for instructors to learn and apply UDL in practice, either independently or through collaboration with a teaching and learning professional, such as an instructional designer or learning designer.

Of these five themes, the first three echoed repeatedly from the literature itself and were addressed in this study's methodology through its design employing control and treatment course sections, and by the second research question of the study which focuses on student outcomes resulting from the modifications made to the course as a result of research activities addressing the first research question. Furthermore, course modifications were documented in detail and each component was aligned to the most appropriate UDL checkpoints that applied to them. As the UDL framework on its own is written as prescriptions for an instructor to apply, it is not sufficient to use it as-is for a qualitative coding

schema. Therefore, I used UDL's core model of the human brain to create classifications for course elements and student outcomes which align to that model. I specifically designed this deductive schema to be generalizable across disciplines so that it could be re-used in similar studies, yet also flexible enough to accommodate additional outcomes and course elements identified by other researchers. As a set of principles for guiding instruction, UDL's success in any setting hinges upon not only acceptance, but also internalization by faculty who teach students. In order to achieve acceptance and internalization, UDL must meet their expectation of quantitative and qualitative rigor as applied to the postsecondary setting. Therefore, this research is my contribution toward developing the specific tools and methods to produce repeatable studies and continue building the evidence that informs the application of UDL in the future.

The last two themes were addressed by employing Tobin & Behling's (2018) "Plus-One" exercise to identify something an instructor perceives as a problem in their course and uses that as an entry point into a conversation about leveraging that problem as an opportunity through the application of UDL. In essence, it starts with the assumption that the problem identified by the instructor is an indicator of a course element that would benefit from UDL's application. These interactions with the instructor are documented using Seidman's (2006) in-depth interview series and presented in this dissertation as a composite profile, giving the instructors a voice in the research results.

Before continuing with this chapter, I would like to highlight table 5.1 shown below. This chapter uses many "shorthand" references to the various modifications made to the two courses. Modifications will be referenced by their identifier, such as A1, B3, etc. The letter 'A' or 'B' refers to it as a modification in either Course A or Course B, respectively. The number after the letter is simply a numeric identifier. The number after the letter is simply a numeric identifier. Rather than reference the modifications summary tables in Chapter 4, I have combined and relisted them below for the reader's convenience, along with the page where each modification is described in detail.

Table 5.1

Course Modification Reference

Modification	UDL Alignment	Page
Course A Modifications		
A1: Tune discussion prompts to connect to personal experience and interpretation.	Principle I, Guideline 7.1	159
A2: Provide a "lead-in" on discussions prior to questions to give them context. This can either be a very short video clip or just a couple sentences.	Principle I, Guideline 7.2	161
A3: Encourage deeper dialogue through a revised discussion rubric and requiring students to write a "circle-back" post to reply to any peers that responded to their initial post.	Principle I, Guideline 8.3	162
A4: Change raw URLs to in-line hyperlinks and turn text references to resources in the course into clickable hyperlinks.	Principle II, Guideline 3.3	164
A5: Allow students to respond to prompt and reply to peers via written discussion post or with a video/audio recording.	Principle III, Guideline 5.1	164
A6: Support multiple means of expression by providing a guide on using non-text tools to post.	Principle III, Guideline 4.2	164
A7: Reinforce discussion expectations by sectioning and bulleting discussion prompts, and including links to the discussion rubric, expectations, providing exemplars, and modifying the syllabus with this info.	Principle III, Guideline 6.1	165
Course B Modifications		
B1: Provide detailed tech instructions and a well-defined, but optional pathway(s) for completing the project.	Principle III, Guideline 4.2	217
B2: Modify the pacing and scaffolding of the project by raising awareness of it earlier in the term and adding an extra, intermediary assignment toward the project which allows students to gain fluency with the technology before attempting the real thing.	Principle III, Guideline 5.3	218
B3: Increase prominence of the project's expectations with a more detailed description in the	Principle III, Guideline 6.1	219

Modification	UDL Alignment	Page
Syllabus, and putting the text of the instructions directly in Brightspace and linking to tech instructions, exemplar, and rubric frequently.		
B4: Provide a detailed project instruction guide detailing each phase.	Principle III, Guideline 6.2	220
B5: Improve students' ability to monitor their progress by creating separate, more granular rubrics for each phase of the project and making these rubrics more visible and functional in the LMS.	Principle III, Guideline 6.4	221

Addressing Research Question 1: Instructor Interviews & Guided Engagement

How does guided engagement of UDL change instructors' perception of their students, courses, and practice as an educator?

The instructor interviews did not produce results that I feel answer this question adequately. That said, this portion of the methodology did reveal insight into the instructor-student dynamic, what instructors value, their anxieties, and how those are reflected in the priorities they choose in the learning environments they provide for their students. This section will reflect upon the instructor-focused research activities and what they produced in comparison to my expectations and how the methodology could have been designed or executed differently. To be clear, I feel that I did receive rich qualitative data and successfully refined it into meaning that informs research and practice as it pertains to UDL. However, that meaning simply did not take the form I was expecting. I observed no instances where the instructors experienced an "ah ha!" moment regarding UDL, nor could I observe any change in instructors' attitudes regarding their course, their students, or UDL. Learning to use and integrate UDL into one's teaching is a gradual process that takes place on a scale that this methodology could not accommodate. Alternatively, it's just as likely that I did not ask the correct questions in the third interview to make those changes evident. Had I even a vague impression of what this portion of the methodology would produce, I would have instead worded the research question something like this:

What does guided engagement of UDL reveal about the inner-workings of the

instructor-student relationship?

      In order to see evidence of the perspective shift this research question was

seeking, more intensive development in the use of UDL for the instructors would

have been needed prior to the start of the study. A set of core UDL-aligned

instructor competencies would have needed to be identified, and cultivated,

similar to what I had produced for the UDL-QAM. I make this assumption based

on the possibly tangential relationship found in the cluster of studies which

focused on pre-service teachers' creation of lesson plans and instruction after

receiving thorough training in the application of UDL (McGuire-Schwartz & Arndt

2007; Courey et al. 2012). That said, despite lacking full internalization at an

expert level, this was not required for both David and Kelly to see value in UDL

early on. This is an observation also found in several faculty-focused studies (Izzo

et al., 2008; Lombardi et al., 2015; Westine et al., 2019), who found that while

faculty often did not have complete understanding of UDL, they valued it and

desired additional training in its usage.

      The instructor interviews also reveal how these instructors' personal

academic histories influence their current priorities in their teaching. Peer

collaboration and reflection are driving forces of David's narrative. They

contributed to his academic and professional success, and as such, he attempts to

engage his students in these activities to allow them to define their own personal

code of ethics as it relates to the field of Engineering. He has also incorporated the practice of reflection as an educator to fearlessly identify where he needs to improve, and then seek out colleagues who are experts in those areas to learn from them.

Kelly has felt a need since high school to see a path through the curriculum that leads to a goal. As such, she was uncomfortable and lacked confidence in her abilities as an adolescent due to her perception of a disorganized high school curriculum that focused on textbooks and passive accumulation of knowledge. The clearly planned curriculum and active learning experiences during her undergraduate and graduate years, such as her nursing practicum, gave her that confidence. Kelly prefers learning through modeling those she considers "experts." In her practice as an educator, she consciously seeks out opportunities to learn new teaching techniques to incorporate. This value she places on expert modeling can be seen reflected in the Video Teaching Project in her course, where her students role-play as genetic counselors educating a patient on a particular condition.

In addition to the respective learning strategies David and Kelly value most, they also have their own anxieties which influence their desires and choices. "Anxieties" should not be construed to be synonymous with "faults." Much like the learning strategies they experienced as students and now value as instructors, anxieties are thought patterns, born from experience, which influence

the instructors' priorities and decisions. David is anxious about his ability to instill the aspects he values into his teaching. In other words, his valuing of reflection and peer collaboration is also tied to his anxieties of not being able to execute learning activities that meet his expectations. In Kelly's case, her anxieties surround her own and her students' success using technology, academic dishonesty, and information literacy, all of which are reflected continually starting with her responses to the Plus-One exercise on the participant selection form, through the discussions we had during her interviews. Before settling on the Teaching Video Project to modify for this study, we had extensive discussions on other proposed modifications tied to these anxieties in the interviews as well.

The instructors' respective teaching values and anxieties influenced their choices for what was modified in their respective courses. For David, it was his course's discussion assignments which he wanted to have the effect of making his students self-reflect and stimulate discussion as engineering colleagues. Instead, they only produced disappointment when the results did not match his expectations, which prompted him to participate in this study in the hope that UDL could help him improve his discussion assignments to achieve his goals. In Kelly's case, her anxiety surrounding the implementation of technology in her course led us to focus on providing support materials to reduce this as a potential barrier to students and consequently simplifying her grading workflow.

This account of David and Kelly's personal history and teaching experience

is validation of expert studies and as such, validation of Meyer and Rose's choice

to construct UDL toward the goal of creating inclusive learning environments that

produce expert learners. Both instructors, as expert learners themselves, were

attracted to UDL out of a desire to become more inclusive educators, realize their

respective teaching values, and mitigate their teaching anxieties. However, the

model revealed by this research question only represents a component of a larger

construct. The second research question's activities highlight nuances that must

be considered. Both this, and the larger implications of the two research

questions considered together are discussed below.

Addressing Research Question 2: UDL Modifications' Effects on Student Outcomes

How does the addition of UDL-driven course modifications affect students'

perceptions, work, behavior, and whether their learning needs are met within an online

course?

Quantitatively, the modifications David and I made in Course A caused

students to like the discussion assignments even less (Affective-aligned outcome).

Students also felt that the discussions did not allow them to demonstrate their

understanding and ability to apply course concepts (Strategic-aligned outcome).

These two statistically significant findings each had a medium effect-size, and

despite being produced from a small sample size, there are similar results in the

qualitative data which may reinforce them. Three (4.62%) student statements in

the treatment section felt that the Topics for Discussion did not help them

understand course topics and concepts. Another three statements expressed that

the discussion themes "felt like a distraction from the other materials."

Additionally, fewer students in the treatment section (7.69%) felt that the

discussions helped their engagement and motivation. In fact there was a

percentage increase in the number of statements expressing a lack of engagement

and motivation attributed to the ethics theme of the discussions (n=3, 4.62%).

Despite the negative quantitative and qualitative effects reinforcing each other

for those outcomes, there were a number of improvements in positive outcomes

represented only in the qualitative data.

The A7 modifications appear to be responsible for a positive effect on

students' understanding of what was expected of them in the discussion

assignments. 10.53% (n=4) of the control section's statements shared this

sentiment while the treatment section had 13.85% (n=9).

The number of students who noted the value of peer-interaction also

improved. There were four (6.15%) students statements which claimed that peer-

interaction in the discussions induced further reflection and self-evaluation. "[the

discussions] challenged my thoughts [on] what other students in the class who

might disagree would think." In fact, 6 (9.23%) of the statements in the treatment

section's student outcomes pertained to self-evaluation and reflection compared

to 2 (5.26%) in the control section. Most striking is the contingent of seven

(10.77%) student statements present in the treatment data that said the Peer

Interaction element of the discussion assignments helped them understand

course concepts and topics (Recognition-aligned outcome). This element-outcome

pair did not exist in the control data, and it remains apparent and attributable to

the A3 modifications when the data is aggregated by modification, instead of

course element.

Initially, the previous observation combined with the negative outcomes

expressed in the course led me to make the interpretation that the additional

posting requirements, while forced and undesirable by students, led to deeper

reflection and a better grasp of the concepts and materials. However, an

alternative interpretation, demonstrated by the diagram in Figure 4.23 from

Chapter 4, is that a contingent of students simply felt strongly against discussion

boards as a form of expressing their knowledge. I interpret this as validation of

UDL's core notion of learner variability. Different students are going to be

engaged by different things based on their unique personal factors. Some

students find that they learn more through collaboration with their peers, while

others value solitary work more.

Peer Replies and Initial Poster Replies both produced statistically

significant results, however I believe these should not be interpreted as evidence

of a positive effect on student outcomes. Recall that modification A3 changed the

posting requirements for the assignments. Students were now required to reply

to any peers that applied to their initial post. These significant results only validate that students followed directions, not that they were more engaged. Finally, access data acquired from the exemplar posts document shows that most students in the treatment section at least opened the document repeatedly through the first half of the term.

In Course B, Kelly and I made modifications to her Teaching Video Project. Quantitatively, there was an improvement in students' perception of how the project motivated and engaged them (Affective-aligned outcome), and how the project met their perceived learning needs (Strategic-aligned outcome). These two statistically significant results each had a medium effect-size. However, based on the qualitative analysis, the quantitative improvement of students' motivation and engagement may not have had anything to do with the UDL modifications. For example, there was an increase in the number of statements relating to Affective-aligned elements which helped student motivation and engagement, however these were course elements which were not modified. Specifically, the Choice of Topic and Instructor Availability elements. That said, it is also possible that the increased visibility and engagement with the project earlier in the term caused students to value choice more, but that is only speculation. Similarly, in the third interview, Kelly made a comment which indicated that she was more deliberate and aware in her feedback during the various submission stages of the project, which could have spurred this increase in students noting her attentiveness.

Certainly not a bad thing if true, but it isn't an element that was intentionally

modified by us. I think it is also important to note that had I chosen to perform

only quantitative analysis, the study would have produced false results. I feel this

validates the mixed-methods approach this study took. The student and instructor

qualitative data exposed the nuances of the quantitative results, giving them

context.

In addition, I performed an analysis of the video submission methods used

between the two courses. The control section had a large contingent of students

(n=16, 64%) who uploaded the full video file directly to the course. This method

was not desirable to Kelly due to the extra labor involved for her to grade them.

Modification B1 in the treatment section included a detailed guide for recording

and submitting the video using university-supported technologies had no students

submitting the video as a direct upload to the course. Instead, a large contingent

(n=19, 70.37%) used the default recording and submission pathway documented

in the recording instructions. Finally, a few metrics were collected in the

treatment section which had no comparable variable in the control section. These

were collected only to provide evidence that the materials created as part of

modification of the teaching video were accessed by students. Figures 4.17 and

4.18 from Chapter 4 show that the Video Teaching Project instructions and

Recording Instructions documents were accessed frequently over the treatment

section's duration.

In terms of the effectiveness of the modifications, one thing which stood out was the near absence of statements relating to the B1 modifications. These were the efforts to reduce the technology barriers in the course by providing a default recording and submission path supported by clearly written, multi-modal instructions, and was one of the first things Kelly wished to focus on regarding the project. This strategically-aligned modification had one Affective-aligned statement in each section where disengagement and demotivation due to technology was expressed. Each section also had one statement in each where students simply mentioned that they were able to successfully perform the recording. The statistics for the recording instructions document show that it was indeed frequently accessed by students. I suspect this is a case where when something as ubiquitous as technology is working and well supported, it fails to be of note unless something is wrong. He, (2014) noted similar results. When it does come up, both by a student participant in He (2014) and by Kelly, it is portrayed as a serious barrier for many students, yet it was only infrequently mentioned in Course B's control and treatment data. Is it perhaps a product of projection of Kelly's own anxiety about technology use and access? Or is having usage or access issues with technology such a taboo that few feel secure enough to mention it? Like the misalignment between David's instructional values and his course objectives, I view this phenomenon in Kelly's course as potential validation for the model of targeted course improvement that I will present later in this

chapter.

Students mentioned the pacing and scaffolding modifications (B2) more in the treatment section, attributing them to helping their engagement and motivation and also helping to understand the project expectations. Similarly, the detailed project instructions (B4) increased the number of statements attributing them to better understanding of the project expectations. The remaining two modification sets, Expectation Prominence (B3), and Rubrics & Progress (B5) had slightly fewer mentions in the treatment section rather than the control, though this could be due simply to the relatively small sample sizes involved, the way I categorized the modifications, or how I assigned the statements. In reflection, I feel that these two modification sets were so granular that they could have simply been folded into the B4 modifications.

Summative Cross-Course Analysis, Other Insights & Resulting Questions

Instructors as Learners

UDL adherents, myself included, are fond of quoting Meyer & Rose's maxim "The curriculum is broken, not the student." The in-depth interviews in this study is a reminder that Instructors are also not "broken". They are themselves learners and I have attempted to frame them as such. They are humans with variability and the ability to learn and reflect and are representatives of the "expert learner" the UDL framework and guidelines were designed to bring forth.

As expert learners and educators, they have the power to alter their

learning environments and practices to be more inclusive. The participant

instructors in this research know what their weaknesses are and each has

developed strategies to mitigate them. Kelly is driven to provide her students with

the best learning experiences possible, so she seeks out learning opportunities for

herself that are not necessarily geared towards teaching and adopts new practices

through the observation of her instructors. David is more interpersonal. He has

the same awareness of his teaching ability, but his approach involves seeking out

and forming relationships with his colleagues that are more knowledgeable and

experienced in teaching. This re-framing of the instructor as a learner is important

for all academic staff colleagues who work to provide them with teaching and

learning support. I expand on this further in the Implications for Postsecondary

Institutions section below.

Instructor Versus Student Perception

In the case of this study, I modeled UDL by providing the instructors with

choice in how we chose to modify their course. Every step of the work we did

was accompanied by companion documents, practical examples, and frequent

reminders of what we had done, and what was left to do. I used The Plus One

exercise to focus their thinking, which still leaves them space to make choices and

express their experience. However, while the Plus One exercise provided an easy

entry-point into UDL-based design, it must be acknowledged that when a

designer works with an instructor, nearly all information about the course,

including what students think of it, is filtered through the instructor's perspective. There are few opportunities that allow for direct observation of what students think the problems in the course are. I believe that if nothing else, this research demonstrates that neither perspective is correct on its own. The instructor and students' perceptions of the learning environment, as well as the course objectives, all need to be considered together in order to decide how to act.

One of the objectives in Course A asks students to "Employ their own ethical framework as a basis for assessment of an action that resonates with the themes of the course." David chose to utilize asynchronous discussion as the means for students to develop and demonstrate their ability in regard to this, and other objectives. He came to me because he was not satisfied with the "depth" of students' discussion posts and dialogue between each other. From his perspective, he felt that his questions and rubric were at fault. As a result, we modified the questions to make them more open to student choice and perspective, altered the rubric to include a social criterion, and required students to reply back to any students that sent them a reply. However, the data suggest that between the more difficult questions, and extra post requirements, we likely irritated some students. The results weren't all negative, though. While unpopular to some students, there was an increase in the perceived value of peer interaction because of the albeit forced, peer interaction. I don't look at the efforts in this course as a failure. In fact, they are clear evidence of UDL's assertion of student

variability. No single modification is going to be met with a universally positive or negative outcome, because students have variability.

If we had administered the student survey in the control section and analyzed its data prior to selecting modifications, we would have seen that students did not see the discussion questions as a problem. In fact, there were relatively few negative sentiments exposed in the qualitative data. This likely would have prompted us to focus on a different area of the course to focus our attention on. I suspect David's perspective of his questions being a problem are the product of the very human tendency to focus on a few instances which confirm our bias or anxiety. This is not to say that the student perspective should be considered alone. Students cannot clairvoyantly expose the activities and knowledge that will help them succeed. They can only share their experience and we can only look for patterns in those experiences and aggregate them.

While not explicitly in the course objectives, David also wanted to induce more interaction between his students as a part of educating them to be professionals. This informal objective "piggybacks" on the actual course objectives relating to ethics in the course. Reflecting on Course A's discussions and thinking about the many comments from students burned out by that mode of expression, I think that we might have seen better results had I helped David separate the social aspect of the discussions from the ethics theme requirement. One of the other contending course components we considered at the beginning of the study

was to revamp Course A's service-learning group project. I feel that would have been a better outlet for David's desire to get his students interacting as colleagues. In true UDL fashion, the discussion assignments could be replaced with a set of options. Students could be given the choice between participating in a debate via asynchronous text discussion, or preparing a short paper, presentation, or video about the same specific issue being discussed that week. This would accommodate both the students who value and learn from the act of interacting with their peers, and those who prefer to work alone.

In Course B, Kelly had the perception that a lack of technology instructions was a problem for her students, thus prioritizing that in our modifications. If I had surveyed and analyzed the course prior to selecting the modifications, we would have seen that there were relatively few statements regarding the use of technology. We also would have seen the pattern of students who were disengaged by the project because they did not like being on camera and perhaps focused on mitigating that through an alternative project.

Effective & Inclusive Course Improvement

As mentioned previously, David was very focused on improving his discussion assignments. While we had some mixed success adapting them to a UDL mindset, there was one student statement from the treatment section that has stuck with me, "I don't look forward to having to do [discussions] as an assignment. I feel they would be a good optional assignment for students who

would like to participate in them." This statement, combined with the fact that none of the students took advantage of the frequently communicated option to post video or audio instead of a text response are strong indicators that we missed the bigger picture. David perceives his students to be introverted and desires to make them more sociable. While this is admirable, it is not actually one of this course's objectives. Ethics and economics, however, are. The application of UDL must be ultimately tied to learning objectives (Rose, Meyer & Gordon, 2014; Tobin & Behling, 2018) since the entire point of UDL is to remove barriers to meeting a course's learning objectives that are imposed in the curriculum due to a students' personal variability. This fact means that a more appropriate UDL modification would have questioned whether discussion assignments were the best way to assess these objectives in the first place. Had we considered that peer interaction was not a course objective, we could have treated it more as an option for expression to suit appropriate students' variability. For example, rather than assessing students' ability to weigh ethical dilemmas via discussion, students could have been given the choice between writing essays, recording presentations, or participating in a structured, asynchronous discussion to demonstrate their capacity with that course objective. Then students could choose the mode of expression that best suited their needs. I believe had we done this, we would have seen fewer negative outcomes relating to the discussions, as students could self-sort themselves into the method of expression

that they felt best suited them. As for David's drive for more peer interaction, decoupling this from the Ethics objective of the course and making an optional, non-graded forum on the front landing page of the course may have fulfilled this request and served as a means of further engaging students and satisfying those students who place more value upon peer interaction in their learning.

        In Kelly's course, we saw clearer results. The modifications we made to her project instructions, and modifying the pacing of the project definitely made themselves present in the data. Students found that those Strategic-aligned elements helped them better understand the project's expectations, caused them to practice more before recording their video, and even helped a couple of them stay engaged and motivated with the project. However, as mentioned previously, one of Kelly's major areas she wished to focus on were the technology barriers she perceived which did not make themselves apparent to any major degree in the qualitative control or treatment data. UDL aside, this, combined with the findings in Course A, suggests that there exists a dynamic between instructors' perceptions of their course, student's perceptions of a course, and course learning objectives which can inform how instructors and the learning or instructional designers assisting them can identify and modify course elements as effectively as possible, to the benefit of the most students. The model I propose below in Figure 5.2 essentially states that Effective and Inclusive Course Improvement lies at the intersection of consideration of the course's learning objectives, the instructor's

experience teaching the course, and students' experience learning in the course.

No single viewpoint can be relied upon to provide the full picture of where a

course should be improved. The area of the instructor's perceptions was

particularly illuminated by RQ1's research activities which suggests a dynamic

between an instructor's personal academic history in what teaching and learning

strategies they value and their anxieties that drive their perceptions and choices

regarding their teaching. This dynamic is illustrated in Figure 5.1.

Figure 5.1

Instructor Prioritization Model
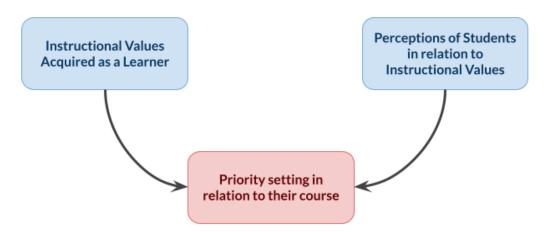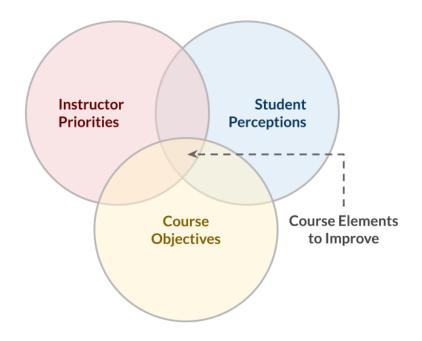
Figure 5.2

Effective & Inclusive Course Improvement Model

Other Findings

Unlike several other studies (Beckman, 2009; Dean et al., 2017; Kumar &

Wildman 2014;) this study did not find any significant difference in student

grades in either course's treatment section. As most of the UDL-aligned

modifications pertained to the Strategic and Affective networks, there is little to

connect this research to studies like Dallas et al. (2016), whose modifications

aligned firmly with the recognition networks. However, put into the terms used in

this study, it appears that Dallas et al.'s findings are an example of in-network

positive relationship between a course element modification and student

outcome that are both Recognition-aligned. However, this cannot really be

considered at odds with the findings in this study, as Dallas et al. did not measure

student outcomes I would have considered aligned with the Affective or Strategic

networks, so we do not know the entire scope of how their video caption

experiment affected students as they were focused solely on comparing student's

information recall, which by the schema presented in this dissertation, would be

classified as a Recognition-aligned outcome.

Limitations

This dissertation research was limited by a number of factors which should

be considered alongside its findings. A few of these limitations are also addressed

with potential solutions for remediation in the "Implications for Future Research &

Institutional Policy" section. As mentioned previously in Chapter 3, this research

occurred in an educational setting within actual credit-bearing courses. As such, it

was unable to provide a true experimental setting with random, representative

student groups and large sample sizes. Time and resources also prohibited it from

being a wide-reaching effort composed of a larger number of participant

instructors, and/or involving complete, UDL-driven revision of courses. However,

I feel that this particular limitation was beneficial, as it forced me to be more

selective and systematic in my methodological choices, and ultimately led to a

much deeper exploration of the application of the UDL framework. The nature of

relying upon student responses as a source of qualitative data also posed some

challenges. There may very well have been both positive or negative effects on

student outcomes due to the UDL modifications in the treatment sections,

however they are only apparent when students mention them in a statement.

Finally, being a sole researcher, the reliability of my interpretations of the

qualitative data should be a consideration. There came a point during my analysis

of the qualitative student data where I simply had to stop performing coding

passes over the data. I second-guessed myself many times and it is very likely

some of the coding does not objectively match my own schema since my

momentary interpretation of a student statement could vary based on my mood,

level of exhaustion, how attentive to the task at hand I was, etc. This issue is

addressed further in the Implications for Future Research section.

While I feel that both instructors in this study accepted UDL and

understood it, at least at a high-level, I can not be sure that they truly internalized

it. This is not a criticism of them as practitioners, but more of a critique of my own

methodology. I learned how much I did not understand about UDL over the

course of performing the qualitative data analysis, therefore I highly doubt the

relatively short introduction I gave both instructors in Stage 2 of the study was

enough for them to fully incorporate UDL into the way they think about teaching.

I was treating the application of UDL as a single "skill," and forgot my own

characterization of UDL as a synthesis of several decades-worth of education

research and practice. UDL requires that the person applying it have fluency in

many pedagogical and technological skills. In retrospect, this is intuitively obvious,

but rather than being an anecdotal account, this study at least provides data and documentation of this insight.

Lastly, this is less than a limitation, and more of a caution for anyone who uses or further evolves this analysis model. While I believe my coding schema faithfully adapts UDL to the task of classifying course elements and student outcomes, I fear that some nuance may be lost or oversimplified in the process of consolidating codes if care is not taken to examine the context of students' statements as it relates to UDL. For example, in reality, I don't really think all course elements can be classified as being solely in the Affective, Strategic, or Recognition domains. Given enough responses from students, I imagine a single course element would gradually have to be separated out into a number of more specific elements that align 1:1 with one of UDL's three networks. For example, take the "Project Instructions" course element from Course B. I classified this as Strategic because its primary purpose is to communicate the process and expectations for the assignment. However, consider the following hypothetical student statement: "The text of the project instructions file was too small to read." If one were strictly looking for mentions of "project instructions" this statement might have its course element code set as such, However, after closer examination, you might realize that the student isn't really talking about the process involved in the instructions, or the expectations, but rather the perceptibility of the text itself, which is clearly the domain of the Recognition

networks. I would have had to create a new, Recognition-aligned course element

called "Presentation of Project Instructions," or something similar, to accurately

reflect the course element being referenced by the student. Furthermore, I'd also

add a new Recognition-aligned student outcome such as "Difficult to Perceive."

This element-outcome pair, accurately reflects the nature of the students'

comment.

Implications for Future Research

The output of this research led to some aspects of the methodology I

would certainly change and strongly recommend other researchers adopt. First

and foremost is the reliability consideration mentioned in the Limitations section. I

strongly recommend that future studies adapting this methodology employ

multiple researchers in the qualitative coding phase. All researchers should have

thorough familiarity with the UDL framework and practiced use of the UDL-QAM.

Researchers should check each other's coding and discuss when members cannot

agree on the classification of a particular course element or outcome, or any other

interpretive issue.

One of this study's unexpected findings was that aspects perceived as

problems in a course may be different depending upon whether the perspective is

that of the instructor, or their students. This methodology planned and

implemented modifications based entirely upon what the instructor perceived to

be problems, or misinterpretation of problems which led to a number of

modifications that may not have had any impact. Therefore, to improve the validity of replications of this study, I believe it is imperative to deploy the student survey in the control section sometime prior to any discussions with the instructor(s) about modifications. The qualitative data from the survey should receive at least one pass using the coding protocol detailed in Table 3.8. The results of this should be considered and discussed with the instructor during one of the interviews or work sessions as part of the modification process. I believe this will lead to UDL modifications that better target students' "pain-points" in the course, help control for any unintentional biases among participating instructors or researchers, and give students more voice in the research.

The instructor and student outcomes of this research are only part of its output. It is my hope that the UDL-aligned qualitative analysis model (UDL-QAM) is reusable and generalizable across many types of courses is the true contribution to this field of study. The UDL guidelines on their own are prescriptive and instructor focused. It is a practice-oriented application of the core UDL model of the brain that does not easily lend itself to research, as I've documented in this dissertation's literature review. To remedy this, the UDL-QAM extends the UDL framework with schemas that align course elements and student outcomes to the UDL brain model. I hesitate to extend it further to the guideline, checkpoint, and expert learning tiers without input and collaboration from CAST and other UDL researchers. The UDL-QAM allows researchers to identify multiple student

outcomes that can be tied back directly to a UDL-aligned course element modification; mitigating the literature's stated ambiguity of whether or not an observed effect in a course is attributable to a UDL-inspired intervention.

Furthermore, the UDL-QAM addresses Saifon's (2021) observation that UDL researchers currently lack a common set of standards, protocols, and methodologies that make it possible to repeat studies and compare them on more equal terms. Without them, each study is its own unique environment that cannot be repeated or easily generalized. While it may be argued that this is simply the nature of qualitative research or research in an educational setting, that will not satisfy faculty and administrators whose expectations are more empirical in nature when they encounter UDL integration as an institutional priority. UDL-QAM may lower the barriers to detailed qualitative studies of postsecondary learning environments and make it possible to categorize data from many smaller studies together under the same generalized terms. This would allow researchers to perform meta-analyses and more advanced statistical modeling.

Finally, I would like to again highlight Kelly's strategy of deliberately observing other practitioners to discover and adopt new teaching techniques. I would like to know the prevalence of this behavior among faculty. As such, a study comparing the adoption of UDL practices by instructors in a professional development opportunity that overtly advocates for UDL versus a session not specifically about UDL that models UDL-inspired design and practice might yield

data to further inform the practice of learning design at postsecondary

institutions.

Implications for UDL

As previously mentioned, the UDL-QAM methodology developed for this

dissertation extends UDL with applications of its model that apply to the

classification of course elements, student outcomes, and their association with

one another. Rather than reiterate the implications from the previous section, I

would like to reflect upon my experience immersing myself in UDL over the

course of this research to relate what I perceive as areas for improvement with

the framework and guidelines. While it is usable in its current form, I feel that a

lack of acknowledgement of online learning environments is a weak point in the

guidelines. I had a difficult time classifying the technology supports added to

courses. Specifically, modification A6 from Course A and modification B1 from

Course B. Ultimately, I decided Checkpoint 4.2, "Optimize access to tools and

assistive technologies" most closely matched the spirit of those modifications, if

not the letter. CAST should consider addressing online learning more by adding a

"provide support materials for digital tool usage" or something similar to the

Action and Expression (Strategic) guidelines, or altering the current wording of 4.2

to include digital tools.

In terms of ICT accessibility, educators continue to associate UDL with

accessibility before pedagogy, and are confused when they do not find standards

which tell them the specifics of how to produce digital content that is accessible

to people with disabilities. CAST doesn't need to reinvent the wheel, as we

already have the W3C's WCAG guidelines and WebAIM for these issues. All it

needs to do is explicitly reference them in the Guidelines as a checkpoint in

Guideline 1 or 2 of the Recognition set.

Finally, when I started this research, I thought I had a good grasp of the

UDL framework and guidelines. However, the act of having to thoroughly and

consistently classify course elements and student outcomes by interpreting

student-supplied statements made me realize how wrong I was, and how easy it is

to misinterpret the guidelines. Similarly, it's also easy for one to "go overboard"

and mistakenly interpret "Provide multiple options for..." as "Provide as many

options as possible for...". Designing a learning environment with such an

interpretation will increase barriers for some students. In other words, UDL needs

some kind of "tempering" mechanism to prevent otherwise well-meaning

instructors and the learning/instructional designers helping them from

"saturating" students with choice. I propose a new checkpoint under the

Recognition or Strategic networks, that states, "Curate options to three-to-five

items," or something similar.

Implications for Postsecondary Institutions

UDL aside, this research also provides institutions a means to make

meaningful use of student feedback in courses. Its methodology can be applied to

analyze any student-provided content that reflects upon a learning experience, and its scalable nature can be used to identify patterns across multiple courses and programs, given enough researchers to do the coding. Such knowledge is invaluable in targeting improvement initiatives, planning effective training, and assessing the effectiveness of those efforts consistently.

As mentioned previously, I have attempted to frame the instructors in this study as learners. This is a crucial point for Teaching & Learning and other similar units at postsecondary institutions. If we are going to advocate that they embrace and use UDL, or any teaching practice for that matter, we ourselves must model UDL in our engagements with them. Therefore, it is crucial that learning designers have a strong practical grasp of UDL and use it in the design of their professional development offerings to faculty. To be clear, I am not simply referring to offering more opportunities advocating for UDL, but rather integrating what UDL teaches as part of all professional development offerings. In other words, we must ensure that we are "practicing what we preach." For example, instead of offering a two-hour workshop on a given topic, have multiple options for "attending" that include a live session and an asynchronous online resource that contains all the same conceptual material from the live session. Instead of requiring live attendance, record the live session and post its recording in the asynchronous version of the workshop. Then instructors can choose which mode they will engage with to "attend" the workshop. This way all instructors, even those with scheduling

conflicts, will have access to the same information. If you find yourself thinking,

"But no one will attend the live session," then I recommend self-reflection on that

reaction. It may be an important indicator of the real versus the perceived value

of your professional development workshops that you can use to improve your

future professional development offerings.

Lastly, consider integrating an activity which challenges instructors to

apply the concepts from the workshop to their teaching in some authentic way.

Not only will this provide data to examine the effectiveness of the workshop, it

gives the instructors the chance to practice what they've learned. Furthermore, if

your institution offers instructors additional compensation, or evidence toward

tenure, the activity can output a deliverable that serves as verification the

instructors participated in and completed the workshop.

As mentioned at the beginning of this dissertation, UDL is complex and not

intuitive to faculty who have minimal prior education in pedagogical methods.

Once again, I must invoke Kelly's strategy of seeking out and modeling the

techniques of other educators as an important indicator. I suspect the modeling of

UDL practices by learning designers in professional development offerings, as

opposed to sessions specifically about UDL, may be the most effective means to

facilitate the adoption of UDL by postsecondary instructors. At the very least, it

represents another possible line of inquiry for future research.

I would like to close this dissertation with a discussion about the

implications of this research for postsecondary education outside the context of

UDL. As a learning designer, I frequently encounter faculty and other people both

inside and outside the realm of education that do not understand what a learning

designer "does." This research, particularly the action research components of the

faculty-focused research question, represents an authentic account of what it's

like for an instructor to work with a learning designer as a true partner in the

process of course development or re-design.

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Appendix A: Summary of Universal Design for Learning Principles, Guidelines, &

Checkpoints

Principle I. Provide Multiple Means of Representation

Guideline 1: Provide options for perception

- Checkpoint 1.1 – Offer ways of customizing the display of information

- Checkpoint 1.2 - Offer alternatives for auditory information

- Checkpoint 1.3 - Offer alternatives for visual information

Guideline 2: Provide options for language, mathematical expressions, and symbols

- Checkpoint 2.1 - Clarify vocabulary and symbols

- Checkpoint 2.2 - Clarify syntax and structure

- Checkpoint 2.3 - Support decoding of text, mathematical notation, and symbols

- Checkpoint 2.4 - Promote understanding across languages

- Checkpoint 2.5 - Illustrate through multiple media

Guideline 3: Provide options for comprehension

- Checkpoint 3.1 - Activate or supply background knowledge

- Checkpoint 3.2 - Highlight patterns, critical features, big ideas, and relationships

- Checkpoint 3.3 - Guide information processing, visualization, and manipulation

- Checkpoint 3.4 - Maximize transfer and generalization

Principle II. Provide Multiple Means of Action and Expression

Guideline 4: Provide options for physical action

- Checkpoint 4.1 - Vary the methods for response and navigation

- Checkpoint 4.2 - Optimize access to tools and assistive technologies

Guideline 5: Provide options for expression and communication

- Checkpoint 5.1 - Use multiple media for communication

- Checkpoint 5.2 - Use multiple tools for construction and composition

- Checkpoint 5.3 - Build fluencies with graduated levels of support for

  practice and performance

Guideline 6: Provide options for executive functions

- Checkpoint 6.1 - Guide appropriate goal-setting

- Checkpoint 6.2 - Support planning and strategy development

- Checkpoint 6.3 - Facilitate managing information and resources

- Checkpoint 6.4 - Enhance capacity for monitoring progress

Principle III. Provide Multiple Means of Engagement

Guideline 7: Provide options for recruiting interest

- Checkpoint 7.1 - Optimize individual choice and autonomy

- Checkpoint 7.2 - Optimize relevance, value, and authenticity

- Checkpoint 7.3 - Minimize threats and distractions

Guideline 8: Provide options for sustaining effort and persistence

- Checkpoint 8.1 - Heighten salience of goals and objectives

- Checkpoint 8.2 - Vary demands and resources to optimize challenge

- Checkpoint 8.3 - Foster collaboration and community

- Checkpoint 8.4 - Increase mastery-oriented feedback

Guideline 9: Provide options for self-regulation

- Checkpoint 9.1 - Promote expectations and beliefs that optimize

  motivation

- Checkpoint 9.2 - Facilitate personal coping skills and strategies

- Checkpoint 9.3 - Develop self-assessment and reflection

Appendix B: Participant Instructor Communication Templates

Announcement Message

Subject: Participate in a study on effective online teaching!

One of our learning designers, Mike Matis, is preparing to do his doctoral research and is looking for two faculty to be participants. Mike will be exploring how the application of the Universal Design for Learning framework affects faculty and their students in online courses. If selected, he'll need between 6-15 hours of your time over the course of the Spring 2021 or Summer 2021 term. If you are interested, fill out the form below. More detailed information about the project can be found below the form link.

Detailed information

There are two overarching goals of this study. The first is to determine the impact Universal Design for Learning (UDL) can have on how faculty reflect about their courses and practice as educators. Two [institution] instructors will be selected for the study. They will participate in a 60 minute workshop session introducing them to Universal Design for Learning and the methodology of the study. They will then work with Mike to select a portion of their course to modify that aligns with UDL's guidelines. Each participating instructor will also be interviewed three times over the course of the semester to capture their

experience.

The second goal is to determine how students are affected by changes made to a course as a result of instructors' UDL knowledge. Students in the instructors' courses will be surveyed to determine what impact the UDL-aligned course modifications had on their learning experience. Depending on the nature of the course modifications, student assignment submissions, and course access logs may also be collected for analysis.

Please feel free to pass this on to your colleagues!

[Link to Participant Selection Survey]

Ad-Hoc Recruitment Message

Hi [Instructor],
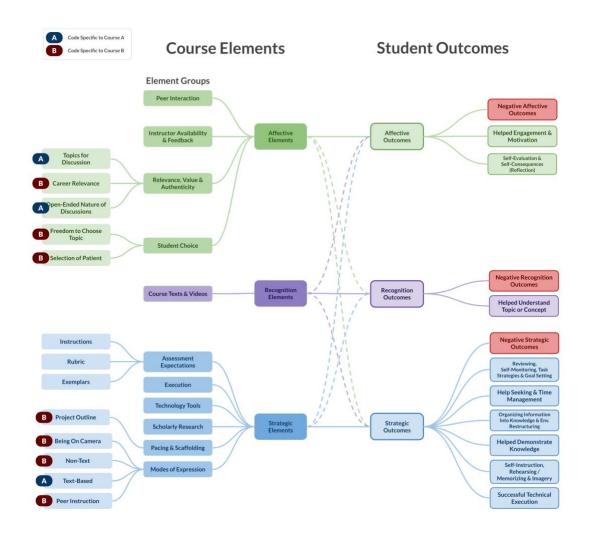
I'm a student in [PhD program]. I noticed that you are teaching [Course] twice this Summer and I'm wondering if you might be interested in participating as a subject in my dissertation research? I'm looking for faculty with consecutive sections of the same course over this Summer term. In a nutshell, the study is about the online course experience for both faculty and students. There's a time commitment of approximately 15 hours spread out between now and the end of Summer involved. This time consists of a three-interview series, and some time for us to select and modify a portion of your course (It's very much like working with a CTEL Learning Designer). Some student data connected to the part of your

course we modify will also be collected. All data (from you and your students) is anonymized.

If you think you might be interested, you can read more about the study from this link. If not, I'm grateful anyway for your consideration and I'd love to know if you have any potentially interested colleagues teaching the same arrangement of course sections over the summer.

Appendix C: Qualitative Code Map

Figure C.1: Qualitative Code Map

Appendix D: Quantitative Student Survey Frequency Tables

Table D.1: *Course A Quantitative Student Survey Frequency Table*

Q10a. The discussions in this course made me feel motivated to work on them.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	1	7.7	7.7
	2	1	7.7	15.4
	3	3	23.1	38.5
	4	2	15.4	53.8
	5	6	46.2	100
	6	0	0	0
	Total	13	100	
Treatment	1	1	7.7	7.7
	2	4	30.8	38.5
	3	2	15.4	53.8
	4	2	15.4	69.2
	5	4	30.8	100
	6	0	0	0
	Total	13	100	

Q11a. The discussions in this course made me feel knowledgeable about the topic.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	1	7.7	7.7
	3	4	30.8	38.5
	4	2	15.4	53.8
	5	4	30.8	84.6
	6	2	15.4	100
	Total	13	100	
Treatment	1	2	15.4	15.4
	2	0	0	15.4

	3	2	15.4	30.8
	4	7	53.8	84.6
	5	1	7.7	92.3
	6	1	7.7	100
	Total	13	100	

Q12a. The discussions in this course gave me a clear sense of what the instructor expected from my posts, and how to go about it.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	1	7.7	7.7
	3	0	0	7.7
	4	3	23.1	30.8
	5	5	38.5	69.2
	6	4	30.8	100
	Total	13	100	
Treatment	1	1	7.7	7.7
	2	1	7.7	15.4
	3	2	15.4	30.8
	4	2	15.4	46.2
	5	6	46.2	92.3
	6	1	7.7	100
	Total	13	100	

Q13. I liked the discussions in this course.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	1	7.7	7.7
	2	1	7.7	15.4
	3	1	7.7	23.1
	4	2	15.4	38.5
	5	5	38.5	76.9
	6	3	23.1	100
	Total	13	100	

Group	Labels	Frequency	Percent	Cumulative Percent
Treatment	1	2	15.4	15.4
	2	3	23.1	38.5
	3	1	7.7	46.2
	4	4	30.8	76.9
	5	3	23.1	100
	6	0	0	100
	Total	13	100	

Q14. The discussions allowed me to effectively demonstrate my understanding and ability to apply course concepts.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	1	7.7	7.7
	2	1	7.7	15.4
	3	1	7.7	23.1
	4	2	15.4	38.5
	5	3	23.1	61.5
	6	5	38.5	100
	Total	13	100	
Treatment	1	2	15.4	15.4
	2	2	15.4	30.8
	3	3	23.1	53.8
	4	3	23.1	76.9
	5	3	23.1	100
	6	0	0	100
	Total	13	100	

Q15. The discussions appropriately measured my understanding and ability to apply course concepts.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	1	7.7	7.7
	3	1	7.7	15.4
	4	4	30.8	46.2

	5	4	30.8	76.9
	6	3	23.1	100
	Total	13	100	
Treatment	1	2	15.4	15.4
	2	2	15.4	30.8
	3	2	15.4	46.2
	4	3	23.1	69.2
	5	4	30.8	100
	6	0	0	100
	Total	13	100	

Q16. I felt the discussions are set up in a way that met my personal learning needs.

Group	Labels	Frequency	Percent	Cumulative Percent
Control	1	2	15.4	15.4
	2	1	7.7	23.1
	3	1	7.7	30.8
	4	3	23.1	53.8
	5	4	30.8	84.6
	6	2	15.4	100
	Total	13	100	
Treatment	1	2	15.4	15.4
	2	3	23.1	38.5
	3	1	7.7	46.2
	4	4	30.8	76.9
	5	1	7.7	84.6
	6	2	15.4	100
	Total	13	100	

Table D.2: *Course B Quantitative Student Survey Frequency Table*

Q10a. The teaching video project made me feel motivated to work on it.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	3	15	15
	2	1	5	20
	3	7	35	55
	4	7	35	90
	5	2	10	100
	6	0	0	0
	Total	20	100	
Treatment	1	0	0	0
	2	2	10	10
	3	4	20	30
	4	6	30	60
	5	8	40	100
	6	0	0	0
	Total	20	100	

Q11a. The teaching video project made me feel knowledgeable about course topics.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	3	15	15
	2	1	5	20
	3	3	15	35
	4	4	20	55
	5	4	20	75
	6	5	25	100
	Total	20	100	
Treatment	1	0	0	0
	2	0	0	0
	3	2	10	10

4	5	25	35
5	8	40	75
6	5	25	100
Total	20	100	

Q12a. The teaching video project gave me a clear sense of what the instructor expected from my work, and how to go about it.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	1	5	5
	2	1	5	10
	3	4	20	30
	4	3	15	45
	5	5	25	70
	6	6	30	100
	Total	20	100	
Treatment	1	0	0	0
	2	0	0	0
	3	2	10	10
	4	2	10	20
	5	7	35	55
	6	9	45	100
	Total	20	100	

Q13. I liked the teaching video project.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	3	15	15
	2	3	15	30
	3	5	25	55
	4	5	25	80
	5	4	20	100
	6	0	0	100
	Total	20	100	
Treatment	1	0	0	0

2	1	5	5
3	9	45	50
4	3	15	65
5	5	25	90
6	2	10	100
Total	20	100	

Q14. The teaching video project allowed me to effectively demonstrate my understanding and ability to apply course concepts.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	2	10	10
	3	2	10	20
	4	6	30	50
	5	6	30	80
	6	4	20	100
	Total	20	100	
Treatment	1	0	0	0
	2	0	0	0
	3	2	10	10
	4	6	30	40
	5	6	30	70
	6	6	30	100
	Total	20	100	

Q15. The teaching video project appropriately measured my understanding and ability to apply course concepts.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	2	10	10
	3	4	20	30
	4	7	35	65
	5	4	20	85

	6	3	15	100
	Total	20	100	
Treatment	1	1	5	5
	2	0	0	5
	3	2	10	15
	4	6	30	45
	5	5	25	70
	6	6	30	100
	Total	20	100	

Q16. I felt the teaching video project is set up in a way that met my personal learning needs.

Group	Label	Frequency	Percent	Cumulative Percent
Control	1	0	0	0
	2	5	25	25
	3	6	30	55
	4	3	15	70
	5	4	20	90
	6	2	10	100
	Total	20	100	
Treatment	1	0	0	0
	2	1	5	5
	3	4	20	25
	4	4	20	45
	5	6	30	75
	6	5	25	100
	Total	20	100	100

Appendix E: Student Qualitative Data Summary

Table E.1: *Full Student Qualitative Data Summary*

# = Count of Statements % = Percent of statements in course section			Course A				Course B			
			Control		Treatment		Control		Treatment	
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
Strategic-Aligned Course Elements										
Unmodified - Strategic										
Execution	Strategic	Organizing Information Into Knowledge & Env. Restructuring							3	2.34%
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting	7	18.42%	9	13.64%	9	9.38%	2	1.56%
		Self-Instruction, Rehearsing/Memorizing & Imagery					3	3.13%	7	5.47%
	Affective	Self-Evaluation & Self-Consequences (Reflection)			2	3.03%			1	0.78%
Peer Instruction	Recognition	Helped Understand Topic or Concept					4	4.17%	14	10.94%
	Affective	Difficulty Interacting					1	1.04%		
		Helped Engagement & Motivation					2	2.08%	2	1.56%
		Self-Evaluation & Self-Consequences (Reflection)					1	1.04%	4	3.13%
Project	Strategic	Helped Understand Expectations					2	2.08%	4	3.13%

| # = Count of Statements | | | Course A | | | | Course B | | | |
| % = Percent of statements in course section | | | Control | | Treatment | | Control | | Treatment | |
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
Outline		Organizing Information Into Knowledge & Env. Restructuring					2	2.08%	1	0.78%
		Time Consuming					1	1.04%		
	Affective	Disliked, Disengaged, Demotivated, Indifferent					1	1.04%		
		Helped Engagement & Motivation					5	5.21%	2	1.56%
		Self-Evaluation & Self-Consequences (Reflection)					1	1.04%		
	Recognition	Helped Understand Topic or Concept					1	1.04%	5	3.91%
Scholarly Research	Recognition	Helped Understand Topic or Concept					7	7.29%	5	3.91%
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting					4	4.17%	3	2.34%
	Affective	Helped Engagement & Motivation					1	1.04%	3	2.34%
Non-Text Mode of Expression	Affective	Covid Video Fatigue							2	1.56%
		Disliked, Disengaged, Demotivated, Indifferent					1	1.04%	2	1.56%
		Helped Engagement & Motivation					2	2.08%	3	2.34%
		Self-Evaluation & Self-Consequences (Reflection)					2	2.08%		
	Recognition	Did Not Help Understand Topic or Concept					1	1.04%		
		Helped Understand Topic or Concept					4	4.17%		

# = Count of Statements % = Percent of statements in course section			Course A				Course B			
			Control		Treatment		Control		Treatment	
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
	Strategic	Helped Demonstrate Knowledge					2	2.08%	1	0.78%
		Too Much Material To Cover In Video					1	1.04%		
Being On Camera	Affective	Disliked, Disengaged, Demotivated, Indifferent					7	7.29%	6	4.69%
Text-Based Mode of Expression	Affective	Disliked, Disengaged, Demotivated, Indifferent	2	5.26%	1	1.52%				
Technology Usage	Affective	Helped Engagement & Motivation			1	1.52%				
Pacing & Scaffolding	Affective	Helped Engagement & Motivation			1	1.52%				
A7 (Expectations - Strategic G6.1)										
Instructions	Strategic	Expectations Too Demanding or Arbitrary			1	1.52%				
		Helped Understand Expectations	2	5.26%	5	7.58%				
	Affective	Disliked, Disengaged, Demotivated, Indifferent			1	1.52%				
Rubric	Strategic	Helped Understand Expectations	2	5.26%	3	4.55%				
Pacing & Scaffolding	Strategic	Expectations Too Demanding or Arbitrary			1	1.52%				
Exemplars	Strategic	Helped Understand Expectations			1	1.52%				

| # = Count of Statements | | | Course A | | | | Course B | | | |
| % = Percent of statements in course section | | | Control | | Treatment | | Control | | Treatment | |
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
B4 (Detailed Project Instructions - Strategic G6.2)										
Instructions	Strategic	Did Not Help Understand Expectations					1	1.04%	1	0.78%
		Helped Understand Expectations					2	2.08%	10	7.81%
		Unclear Expectations for Patient							1	0.78%
B3 (Expectation Prominence - Strategic G6.1)										
Exemplars	Strategic	Helped Understand Expectations					7	7.29%	6	4.69%
	Affective	Helped Engagement & Motivation							1	0.78%
B2 (Pacing & Scaffolding - Strategic G5.3)										
Pacing & Scaffolding	Strategic	Help Seeking & Time Management							1	0.78%
		Helped Understand Expectations							3	2.34%
	Affective	Disliked, Disengaged, Demotivated, Indifferent					1	1.04%	1	0.78%
		Helped Engagement & Motivation							2	1.56%
	Recognition	Helped Understand Topic or Concept							1	0.78%
Project Outline	Affective	Helped Engagement & Motivation							1	0.78%
B5 (Rubric & Progress - Strategic G6.4)										
Rubric	Strategic	Helped Understand Expectations					3	3.13%	1	0.78%
B1 (Tech Instructions - Strategic G4.2)										
Technology	Strategic	Successful Technical Execution					1	1.04%	1	0.78%

# = Count of Statements			Course A		Course B	
% = Percent of statements in course section			Control	Treatment	Control	Treatment
Course Element	UDL Outcome Alignment	Student Outcome	# %	# %	# %	# %
Usage	Affective	Disliked, Disengaged, Demotivated, Indifferent			1 1.04%	1 0.78%

Affective-Aligned Course Elements

Unmodified - Affective

Course Element	UDL Outcome Alignment	Student Outcome	# %	# %	# %	# %
Choice of Topic	Affective	Helped Engagement & Motivation			3 3.13%	7 5.47%
	Recognition	Helped Understand Topic or Concept				3 2.34%
		Limited Learning to One Disorder			1 1.04%	2 1.56%
	Strategic	Reviewing, Self-Monitoring, Task Strategies & Goal Setting				2 1.56%
Instructor Availability & Feedback	Strategic	Help Seeking & Time Management				2 1.56%
		Helped Understand Expectations	1 2.63%		1 1.04%	
	Affective	Helped Engagement & Motivation				3 2.34%
		Self-Evaluation & Self-Consequences (Reflection)				1 0.78%
	Recognition	Helped Understand Topic or Concept	1 2.63%			
Career Relevance	Affective	Self-Evaluation & Self-Consequences (Reflection)			5 5.21%	2 1.56%
Choice of Patient	Strategic	Difficulty Finding			2 2.08%	1 0.78%
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting				1 0.78%
	Affective	Disliked, Disengaged, Demotivated,				1 0.78%

# = Count of Statements			Course A				Course B			
% = Percent of statements in course section			Control		Treatment		Control		Treatment	
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
		Indifferent								
A1 (Authenticity - Affective G7.1)										
Topics for Discussion	Affective	Disliked, Disengaged, Demotivated, Indifferent			3	4.55%				
		Helped Engagement & Motivation	6	15.79%	5	7.58%				
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%						
	Recognition	Did Not Help Understand Topic or Concept			3	4.55%				
		Did Not Help with Other Course Topics	1	2.63%	3	4.55%				
		Helped Understand Topic or Concept	1	2.63%	5	7.58%				
A3 (Community - Affective G8.3)										
Peer Interaction	Affective	Disliked, Disengaged, Demotivated, Indifferent	1	2.63%	1	1.52%				
		Helped Engagement & Motivation	2	5.26%	3	4.55%				
		Self-Evaluation & Self-Consequences (Reflection)	1	2.63%	4	6.06%				
	Recognition	Helped Understand Topic or Concept			7	10.61%				
Recognition-Aligned Course Elements										
Unmodified - Recognition										
Course Texts	Recognition	Helped Understand Topic or Concept	4	10.53%	2	3.03%				

| # = Count of Statements | | | Course A | | | | Course B | | | |
| % = Percent of statements in course section | | | Control | | Treatment | | Control | | Treatment | |
Course Element	UDL Outcome Alignment	Student Outcome	#	%	#	%	#	%	#	%
& Videos		Insufficient Material in Course For Project					1	1.04%		
		Too Long for a Discussion Assignment	1	2.63%						
	Affective	Disliked, Disengaged, Demotivated, Indifferent			1	1.52%				
		Helped Engagement & Motivation	5	13.16%	2	3.03%				
	Strategic	Did Not Align With Discussion Topics			1	1.52%				
		Reviewing, Self-Monitoring, Task Strategies & Goal Setting					2	2.08%	2	1.56%

Appendix F. Course B Teaching Video Project Recording Instructions

(The original visual elements, such as screenshots, have been removed to save space. Bracketed text indicates something functional in the original that was removed to protect subject anonymity)

There are multiple ways to produce your recording. Below you will find one possible (recommended) route that utilizes University-supported tools, but feel free to do things a different way if you have access to and knowledge of different tools. To summarize, you'll create a recorded meeting in Zoom, wait for the video to automatically be copied to Kaltura's My Media tool, and then submit it on Brightspace. There is also a [link to demonstration video]. **For more information about the content and expectations for the teaching session project, see the [Link to project instructions].**

—

Contents

[All items in original were listed clickable and linked to respective section of the document]

1. Before You Begin
2. Install Zoom
3. Logging into Zoom
4. Make sure you are logged in with the right account
5. Starting a Meeting
6. Make sure your Microphone and Camera are not muted
7. Recording Your Meeting
8. Finding Your Recording
9. Submitting your Recording in Brightspace
10. OPTIONAL: Editing Your Recording
11. OPTIONAL: Uploading a Video not recorded using these instructions to Kaltura

—

Before You Begin

- If you run into problems logging into your [institution network domain] account, installing Zoom, or other technical issues or questions, please contact the IT helpdesk at **[IT phone #]**, or [IT email].

- **You will need your [institution domain name] account's username and password.** These instructions will not work without it!

- **You will need a device with a microphone and camera capable of capturing video.** This could be a Mac or Windows, laptop, tablet, Android-based phone or iPhone. The screenshots in these instructions use the desktop version of Zoom, but there should be equivalently named controls for all versions. They just might be in a different spot than depicted, or look slightly different. [Zoom's Support Center](#) has instructions for all versions of its software if you get stuck.

—

Install Zoom

1. [Download and install the Zoom app](#) if you don't already have it.

   a. If you already have Zoom, [make sure it is up to date](#).

2. Open the Zoom App. The icon should look similar to the one to the right.

—

Logging into Zoom

You need to be correctly logged into Zoom with your [institution network domain] account for the recording instructions to work. After opening Zoom, you may be presented with a login screen similar to the one shown on the next page. **If it does NOT show a login box, proceed to [link to the next section.]**

1. Click the **Sign in with SSO** button. A popup titled "Sign in with SSO" will appear.

2. Type **[state]** into the text field.

3. Click the **Continue** button.

4. If you were already logged into the campus portal in your web browser, the main Zoom window will appear. Otherwise, the [institution network name] login page will appear.

5. Enter your [institution network domain] account username and password and click the **Login** button.

6. The main Zoom window will appear.

—

Make sure you are logged in with the right account

You need to be correctly logged into Zoom with your [institution network domain] account for the recording instructions to work. If you didn't receive a login screen after opening the Zoom App , please use the following instructions to verify you are logged into the app with your [institution network domain] account.

1. Click the **profile badge** in the upper-right corner of the Zoom window. A menu will appear. **Your profile badge may be a different color or have a photo than the one in the screenshot to the right.**

2. At the top of the menu, it should show your name and your [institution network domain] email address. (It's okay if it shows your email address with asterisks in it.)

3. **If you saw your name and [institution network name] in Step 2,, you can**

skip this step and proceed to the next section. Select **Switch Account** from the same menu and perform the steps in the [link to previous section].

—

Starting a Meeting

1. Click the **Meetings** button at the top of the Zoom app window.
2. Select the **My Personal Meeting ID** tile in the left column.
3. **Skip the following if your "client" will be in the same room as you when you record your video.**
   a. Click the **Copy Invitation** button on the right side of the Zoom app window.
   b. Paste the invitation into an email to the person playing the role of your "client" by using Ctrl + V on Windows, or Cmd + V on a Mac. You can also right-click and click Paste.
4. Click the **Start** button on the right side of the Zoom window when you are ready to start the Zoom Meeting.

—

Make sure your Microphone and Camera are not muted

After you start your meeting, check that your microphone and camera are **not muted**. You can determine this by looking at the microphone and camera buttons in the lower-left corner of the Zoom meeting toolbar. If there is a red slash through either button, it means that function will not be recorded by Zoom.

—

Recording Your Meeting

Once you've verified that your microphone and camera are not muted and

functioning, do the following:

1. If the person acting as your "client" is in the same room as you, position your device so that it can see both you and your client and sit facing each other. **Be sure to speak up, so the device's microphone picks up both of your voices.** Here is an example of a [link to a previous student's video done in this fashion].

2. Click the **Record** button on the Zoom meeting toolbar. A popup menu will appear.

3. Select **Record to the Cloud**. It is important that you select this instead of the other option because it will save you a lot of extra steps later.

4. When you are finished recording, click the **End** button in the lower-right corner of the Zoom meeting window and select **End Meeting For All**.

—

Finding Your Recording

Do this at least once before attempting to submit your video! After you've ended your meeting, Zoom will begin processing your recording and getting it ready for you to access. This process does not happen on your device, but on Zoom's computers on the internet, so it's safe to turn your computer off. **It may take 30 minute to an hour before your recording is available**, so take a break before attempting the next step.

Zoom will store your recording in the University's Kaltura media platform. Like Zoom, every student has access to Kaltura. To get to your recording, do the following:

1. Go to our course in Brightspace.

2. Click the **Tools** menu in the blue navbar.

3. Select **My Media**.

   a. If you are asked to accept cookies or click a checkbox, this is normal and only happens once.

4. You should see a list of your media, which if this is the first time you've used Kaltura, you'll likely only see one video.

5. Click the thumbnail for the video or its blue header text to watch your recording.

[Watch a demonstration of these instructions - Link to demonstration video].

—

Submitting your Recording in Brightspace

If you did not use the instructions from the previous sections to record your video, [see these instructions to upload the video file to Kaltura - link to optional section below] before attempting to submit your video. If you would like to edit out unwanted parts of your recording, see the optional section on [using Kaltura's video editor - link to optional section below] and then come back to this section afterward. Otherwise, follow these steps to submit your recording for grading:

1. Go to our course in Brightspace.

2. Click the **Content** link in the navbar.

3. Click the module containing the assignment you have to submit a recording for.

4. Click on the link for the assignment and scroll all the way down to the text area at the bottom of the page.

5. Type some text first if you wish.

6. When you are done typing, click the **Insert Stuff** button. The Insert Stuff menu will appear.

7. Select **Insert Kaltura** from the list.

8. It may take a few moments, but a list of the contents of your **My Media** page will appear. Click the **Embed** button next to the recording you are submitting.

   a. **If you receive an error message**, it's very likely you need to do the steps in the [Finding your Recording section. - link to optional section below] Once you've visited the My Media page once, the Insert Kaltura option should work for you.

9. Click the **Insert** button on the next popup that appears.

10. Click the blue **Submit** button at the bottom of the page.

11. Click the blue **Done** button on the next page.

[Watch a video demonstrating these instructions. - link to demonstration video]

NOTE: The **Insert Stuff** button depicted in the video is the older version. The one shown in the Step 6 illustration above is the new, correct one.

OPTIONAL: Editing Your Recording

If there is footage at the beginning, end, or middle of your recording that you would like to remove, you can do so using Kaltura's editor. NOTE: You don't have to do all of these steps. Just do the ones appropriate to your situation. **TIP:** Press the **spacebar** on your keyboard to quickly pause the recording as it plays.

1. Go to our course in Brightspace.

2. Go to your Kaltura **My Media** page as described in the ["Finding your Recording" - link to previous section] section.

3. Click the **pencil** icon in the row for the video you wish to edit.

4. Click the **Launch Editor** button. The **Kaltura Video Editor** will appear.

5. **To remove footage from the <u>beginning</u> of your recording:**

    a. Play your recording immediately past the part you want to remove and pause the video.

    b. Click the **Set In** button. This will move the beginning of the video to the point you paused on in the previous step.

6. **To remove footage from the <u>end</u> of your recording:**

    a. **Fast-Forward** to near the end of your video and pause it at the point you would like your video to end.

    b. Click the **Set Out** button. This will move the **end** of the video to the point you paused on in the previous step.

7. **To remove parts from the <u>middle</u> of your recording:**

    a. Play or fast-forward your recording to the point immediately before the part you want to remove and pause the video.

    b. Click the **Split Clip** button. This will split the filmstrip at the bottom of the editor at the point you paused the video.

    c. Unpause the video and let it play immediately past the unwanted footage and then pause it again.

    d. Click the **Split Clip** button again.

    e. Click the **middle** portion of the filmstrip that contains the unwanted footage.

    f. Click the **trashcan icon** to delete the unwanted footage.

  8. Read the next section on how to save your edited recording

Saving the Edited Recording

After editing your recording, I strongly recommend using the **Save a Copy** button instead of the Save button. This will create a **copy** of your recording with any edits you made, but preserve the original, unedited recording in case you accidentally made a mistake. Be sure to give the copy a name that distinguishes it from your original, unedited recording so you can easily tell the difference between it and the original in your My Media list.

The actual saving of your edited video may take some time, Fortunately the work is being done in Kaltura's computers on the internet, so once you've clicked the **Save a Copy** button and given the copy a name, it is perfectly safe to close the page, turn off your device, etc. Don't panic if your edited recording doesn't show up in My Media right away. It can take time for Kaltura to get it ready. Just take a break and check to see if it's there in an hour.

[Watch a video demonstrating these instructions. - link to demonstration Video]

OPTIONAL: Uploading a Video not recorded using these instructions to Kaltura

You **ONLY** need these instructions if you used something other than these instructions to record your video, or if you selected "Record on This Computer" instead of "Record to Cloud" in Zoom. Follow these instructions to upload the video to Kaltura.

  1. Go to our course in Brightspace.

2. Click the **Tools** menu in the blue navbar.

3. Select **My Media**. If you are asked to accept cookies or click a checkbox, this is normal and only happens once.

4. Click the **Add New** button. A menu will appear.

5. Select **Media Upload**.

6. Click the **Choose a File to Upload** button.

7. Select the video file to be uploaded and fill in the requested info on the video upload page.

8. When the video finishes uploading, it will take some time for Kaltura to process it. This is normal. You can now proceed to the instructions in the [Submitting your Recording in Brightspace. - link to previous section]

Appendix G. Course B Original Control Section Rubric

Criteria	Points
1. Written Teaching Plan (APA format) – 30 points Title Page Outline of Content • Description of Condition • Genetic Etiology • Occurrence of Condition • Assessment of Condition if available (Genetic Testing, Physical exam, Family History) • Treatments • Recurrence risks; Transmission to offspring if any • Any current research on treatments, testing, diagnosis • Help with decision making (testing and decisions are made) • Psychological Issues (Coping with new disorder – fear, anger, shock, guilt etc.) • Family supports • Community Resources • Visual Aids	35
Interview/Counseling/Education Skills • Open ended questions; focused; closed • Reflective Rephrasing • Reflecting Redirection • Promoting shared language • Use of silence • Use clear, understandable terms • Avoid medical jargon • Don't equate the person with the diagnosis • Start from general to specific • Allow for questions • Correct/clarify misunderstandings • Be attentive • Visual Aids used in teaching session	30

Self-Critique of Session (APA Format)
   ● Positive communication
   ● Level of information appropriate for client's educational background
   ● Sensitivity to cultural beliefs
   ● Educational tools helpful in providing information about the condition.
	25

4. List of References APA Format	10
Comments: APA format is for title page and references. Informal outline used	

Appendix H. Course B Teaching Video Project Instructions

(Bracketed text indicates something functional in the original that was removed to protect subject anonymity)

[All items in original were listed clickable and linked to respective section of the document]
Grading Rubric
Part 1: Practice Video - Due in Module 3
Part 2: Teaching Outline - Due in Module 6
Part 3: Teaching Session Video - Due in Module 7
Part 4: Reflection - Due in Module 7

Project Summary

You will digitally record yourself role-playing as the nurse teaching a "client" (played by a classmate, friend, or family member) about a genetic disorder. The final recorded session will be submitted as a video/audio recording on Brightspace. The project is divided into four parts:

1. A practice video (Due in Module 3)

2. Your teaching Outline (Due in Module 6)

3. The actual teaching session video (Due in Module 7)

4. A brief reflection about your video (Due in Module 7)

This document will cover each part of the project in detail. I have also provided [detailed tech instructions - Link to Recording Instructions document] in a separate document demonstrating how to record and submit your videos to minimize any tech anxiety you might have.

The "client" will role-play a potential risk for or a current genetic condition. Your classmate/other will be allowed to ask questions to you (nurse educator) during the session. You as the nurse educator will provide nursing genetic education and

support for this scenario to the client, using patient education materials. (If using a fellow student in the class as the patient, you will each select a different genetic topic to role play as the nurse).

The intent of this project is to demonstrate your ability to convey the course content in its intended uses, i.e. patient education, support and referrals. The genetic teaching/counseling session should last only 10-15 minutes. Click the following link to [watch an example of a previous student's Teaching Session Video - Link to Exemplar].

Grading Rubric

Grades will reflect the ability to succinctly summarize a topic, clearly state the above requirements and communicate the relevance to health care practices. **Click the Part headings in the rubric below for detailed instructions.**

Genetic Teaching Session Project (25% of your course grade)	
Part 1: Practice Video (Due in Module 3) [Link to respective section of document]	
● Identified a "client"	5 Points
● Determined if they would record the client in the same room or remotely	5 Points
● Embedded 30 sec. or less Practice Video that includes the students' face and voice	5 Points
Part 1 Total: **15 Points**	
Part 2: Teaching Outline (Due in Module 6) [Link to respective section of document]	
● APA Format (7th Edition)	5 Points
● Title Page	5 Points
● [Session Content Outline (click link for specifics) - Link to respective section]	15 Points
● List of References in APA Format	10 Points
Part 2 Total: **35 Points**	

Part 3: Teaching Session Video (Due in Module 7) [Link to respective section of document]	
● Video is 10-15 minutes long	4 Points
● Adherence to [Session Content Outline - Link to respective section] described in Teaching Outline	8 Points
● Usage of [Positive Therapeutic Communication techniques - Link to respective section]	8 Points
● Use of visual aids and patient resources	4 Points
● [Delivery of educational content - Link to respective section]	6 Points
Part 3 Total: **30 Points**	
Part 4: Reflection (Due in Module 7) [Link to respective section of document]	
● Addresses [Delivery of educational content - Link to respective section]	4 Points
● Addresses Usage of [Positive Therapeutic Communication - Link to respective section]	4 Points
● Addresses Level of information appropriate to the client's educational background	4 Points
● Addresses Sensitivity to client's cultural beliefs	4 Points
● Addresses Educational tools helpful in providing information	4 Points
Part 4 Total: **20 Points**	
Project Total: **100 Points**	

Part 1: Practice Video - <u>Due in Module 3</u>

Before you start Outlining the topic and content of your session, I want you to practice using the technology first to reduce potential technical difficulties when you do the real thing. You will submit a very short (less than 30 seconds) practice video which shows your face and records your voice. When you post the video, you will also give me some brief details about your Outlines for the video project.

I have provided a detailed set of instructions you can follow to produce this and the final project video, as well as how to submit them correctly in Brightspace. Click the following link to [read the Recording Instructions - Link to recording

instructions document].

To complete this part of the project:

1. Identify someone to role-play as the "client" for your teaching video. It can be a classmate, friend or family member. **At this point, you are just identifying this person. You do not need them present to complete the Practice Video.**

2. Decide how you will record your video. Will they be in the same room as you when you record, or will they connect from their own device remotely. **Don't worry, the [Recording Instructions - Link to recording instructions document] cover both cases.**

3. Use the [Recording Instructions - Link to recording instructions document] to create the practice recorded zoom meeting.

4. During the practice meeting, make sure both your webcam and microphone are on and tell me your answers to steps 1 and 2 above. The whole thing only needs to be a few seconds.

5. Go to our course in Brightspace. Find the link for this assignment in Module 3 and click it. Embed your practice video in the text area at the bottom of the page using the steps outlined in the following section of the [Recording Instructions - Link to recording instructions document].

Notes

- If you tend to forget how to do technical things, please consider running through the process as many times as you need to feel confident.
- If you run into technical difficulties with your [institution network domain] account, Zoom or Kaltura, contact the **IT helpdesk at [IT phone and email**

contact].

Part 2: Teaching Outline - <u>Due in Module 6</u>

To prepare for your session, you will write a teaching Outline that focuses on key components of genetic teaching/counseling. Your Outline should include the following components:

- **Formatting according to APA (7th Edition)**
- **Title Page**
- **Session Content Outline**, which includes**:**
  - Description of Condition
  - Genetic Etiology
  - Occurrence of Condition
  - Assessment of Condition if available (Genetic Testing, Physical exam, Family History)
  - Treatments
  - Recurrence risks; Transmission to offspring if any
  - Any current research on treatments, testing, diagnosis
  - Help with decision making:
    - How decisions are made within the family and
    - Deciding to select genetic testing and include how results will affect the patient and family)
  - Psychological Issues (Coping with anticipated shock, fear, anxiety, guilt, anger, loss etc.) in being diagnosed with a genetic disorder)
  - Family supports
  - Community Resources
  - Visual Aids you Outline to use during the session
- **References** section formatted according to APA 7th edition guidelines.

Upload your Teaching Outline as a .docx or .pdf file under the assignment link in Module 6 in our Brightspace course.

Part 3: Teaching Session Video - <u>Due in Module 7</u>

Using your Teaching Outline (and my feedback on it), record a 10 - 15 minute video where you play the role of a nurse teaching your "client" about your chosen genetic condition. Embed the video in the Teaching Session Video assignment found in Module 7.

- Use the [Recording Instructions - Link to recording instructions document] to help you with the technical parts.
- **Expectations of your Session Delivery:**
  - Exceeding
    - Holds attention with audience with the use of direct eye contact, seldom looking at notes
    - Speaks with fluctuation in volume and inflection to maintain audience interest and emphasize key points
  - Meeting
    - Consistent use of direct eye contact with audience, but still returns to notes
    - Speaks with satisfactory variation of volume and inflection
  - Approaching
    - Displays minimal eye contact with audience, while reading mostly from the notes
    - Speaks in uneven volume with little or no inflection
  - Beginning
    - Holds no eye contact with audience, as entire report is read from notes
    - Speaks in low volume and/or monotonous tone, which causes audience to disengage
- **Utilize Therapeutic Communication** techniques throughout your video.
  - Open ended questions; focused; closed
  - Reflective Rephrasing

- ○ Reflecting Redirection
- ○ Promoting shared language
- ○ Use of silence
- ○ Using clear, understandable terms
- ○ Avoiding medical jargon
- ○ Separating the person from the diagnosis
- ○ Starting from general to specific
- ○ Allowing for questions
- ○ Correcting/clarifying misunderstandings
- ○ Attentiveness
- ● Here is an [example of a previous student's Teaching Session Video - - Link to exemplar video].

Part 4: Reflection - Due in Module 7

After recording your teaching session video, you will write a reflection in APA format addressing the following aspects of your work.

1. [Delivery of educational content - Link to relevant section].
2. Usage of [Positive Therapeutic Communication - Link to relevant section],
3. Level of information appropriate to the client's educational background,
4. Sensitivity to client's cultural beliefs, and
5. Educational tools helpful in providing information.

I will provide feedback on your session video and your reflection.

Appendix I. Full Course Modification Proposals

Table I.1: *Course A Full Course Modification Proposal*

Scope of Modifications: Course Discussions will be modified to add options for expression with accompanying technical and pedagogical supports. The goal being to stimulate more thorough/thoughtful posts and richer dialogue between students.

Applicable Course Objectives

1. Analyze a topic relating to diverse human cultures and the natural world that has a significant ethical dimension and that is shaped by conflicting goals, values, traditions, institutions or structures.

2. Describe their deliberative process for informed decision-making (e.g. weighing evidence, generating multiple alternatives and articulating the rationale for a final decision).

3. Articulate their personal viewpoints as informed by specialized perspectives (including those encountered in previous coursework) and distinguish their viewpoints from those of others.

4. Employ their own ethical framework as a basis for and assessment of an action that resonates with the themes of the course.

5. Demonstrate effective oral and written communication that draws on the higher-level cognitive skills: analysis, synthesis and evaluation

Course A Modifications

Parenthetical numbers reference applicable UDL Checkpoints

UDL Principle I. Multiple Means of Engagement (Affective Network)

- Tune discussion prompts to connect to personal experience and interpretation. **(7.1)**

- Provide a "lead-in" on discussions prior to questions to give them context. This can either be a very short video clip or just a couple sentences. **(7.2)**

- Encourage deeper dialogue through a revised discussion rubric and requiring students to write a "circle-back" post to reply to any peers that responded to their initial post. **(8.3)**

UDL Principle II. Multiple Means of Representation (Recognition Network)

- Change raw URLs to in-line hyperlinks and turn text references to resources in the course into clickable hyperlinks. **(3.3)**

UDL Principle III. Multiple Means of Action & Expression (Strategic Network)

- Allow students to respond to prompt and reply to peers via written discussion post or with a video/audio recording. **(5.1)**

- Support multiple means of expression by providing a guide on using non-text tools to post. **(4.2)**

- Reinforce discussion expectations by sectioning and bulleting discussion prompts, and including links to the discussion rubric, expectations, providing exemplars, and modifying the syllabus with this info. **(6.1)**

Table I.2: *Course B Full Course Modification Proposal*

Scope of Modifications: The Genetic Teaching Video Project will be modified with supports to better communicate expectations of the assignment and lower barriers presented by technology.

Applicable Course Objectives

1. Articulate the basic principles of human genetics/genomics with appreciation of the expanding scientific advances that impact professional nursing/health practice including: DNA structure and the basis of genetic variation, patterns of inheritance (Mendelian & multifactorial), the structure and function of chromosomes and the human genome, population genetics, and cancer genetics.

2. Explain the expanding scientific advances in genetics/genomics that are important to health and health care (e.g. professional nursing practice) including: chromosome translocation, molecular diagnosis and newborn screening, developmental genetics, carrier screening and genetic risk assessment (including cancer risk assessment), pharmacogenetics, and gene therapy.

4. Evaluate the clinical applications of protective and predictive genetic/genomic factors, which influence the health of individuals, families, groups, communities and populations.

Course B Modifications
Parenthetical numbers reference applicable UDL Checkpoints

UDL Principle III. Multiple Means of Action & Expression (Strategic Network)

- Provide detailed tech instructions and a well-defined, but optional pathway(s) for completing the project. **(4.2)**

- Modify the pacing and scaffolding of the project by raising awareness of it earlier in the term and adding an extra, intermediary assignment toward the project which allows students to gain fluency with the technology before attempting the real thing. **(5.3)**

- Increase prominence of the project's expectations with a more detailed description in the Syllabus, and putting the text of the instructions directly in Brightspace and linking to tech instructions, exemplar, and rubric frequently. **(6.1)**

- Provide a detailed project instruction guide detailing each phase. **(6.2)**

- Improve students' ability to monitor their progress by creating separate, more granular rubrics for each phase of the project and making these

rubrics more visible and functional in the LMS. **(6.4)**

Appendix J. Research Log

Table K.1: *Research Log*

Note: links to artifacts removed to protect subject anonymity

Date	Stage	Course	Events & Notes	Artifacts
2020-11-05	0		IRB Submission	Submission
2020-11-12	0		IRB Revisions	
2020-11-16	**0**		**IRB Approval - Phase 0 Complete**	**Approval Letter**
2020-11-20	1		Recruitment Email & Survey Sent	Email Text, Survey
2021-02-04	1		Several other informal efforts to get more survey responses	Ad Hoc Communication
2021-02-08	1		Parsed out two pairs to engage as participants and contacted them. Decided to prioritize a pair with a Spring-Summer consecutive course sequence to allow for a looser timeline.	Confirmation Email
2021-02-08	1	A	**Secured Participant A**	
2021-02-09	1	B	**Secured Participant B**	
2021-02-16	1	A & B	Began scheduling Introductory Sessions	Scheduling Email Text
2021-02-16	1	A	Scheduled Intro Session for March 2nd @ 1pm	Google Calendar Event
2021-02-17	1	B	Scheduled Intro Session for Feb 26th @ 2:30pm	Google Calendar Event
2021-02-26	**1**	**B**	**Removed Participant B from study due to schedule change. Search for replacement underway.**	

2021-03-02	2	A	Conducted Initial Engagement	Session Recording
2021-03-02	2	A	Scheduled Interview 1 for March 16 @ 1pm	Google Calendar Event
2021-03-02	2	A	Scheduled Interview 2 for March 23 @ 1pm	Google Calendar Event
2021-03-02	2	A	Sent Post-Intro Follow-up email	Email Text
2021-03-08	2	A	Received Signed Inform Consent form from Participant A	Participant A Signed Informed Consent form
2021-03-16	2	A	Conducted Interview 1	Participant A Interview 1
2021-03-22	2	B	**Secured replacement Participant B**	
2021-03-22	2	B	Scheduled Intro Session for March 24th @ 11:00am	Google Calendar Event
2021-03-22	**1**	**A & B**	**Stage 1 (Participant Selection) Complete**	**Phase 1 Folder**
2021-03-23	2	A	Conducted Interview 2	Participant A Interview 2
2021-03-23	2	A	Scheduled Work Session for March 25th @ Noon	
2021-03-24	2	B	Conducted Initial Engagement	Session Recording
2021-03-24	2	B	Scheduled Interview 1 for March 31st @ 2pm	Google Calendar Event
2021-03-24	2	B	Sent Post-Intro Follow-up email to Participant	Email Text
2021-03-25	3	A	Pitched several modification ideas. Scheduled next session.	Course A Brainstorming Document

2021-03-31	2	B	Interview 1 & Scheduled Interview 2	Participant B Interview 1
2021-04-01	3	A	Finalized on modifying discussions. Scheduled next session and began Course Modification Proposal.	Course A Brainstorming Document
2021-04-08	3	A	Presented draft Modification Proposal. Set control session student survey date & communication. Tuned survey questions to modification. Scheduled next session.	Course A Modification Proposal
2021-04-11	4	A	Deployed Student Survey in control section	Course A Student Survey
2021-04-14	2	B	Interview 2 & scheduled first work session.	Participant B Interview 2
2021-04-14	**2**	**A & B**	**Stage 2 (Intro, First and Second Interview) Complete**	**Stage 2 Folder**
2021-04-23	3	A	Finalized Modification Proposal. Began implementing modifications.	Course A Modification Proposal
2021-04-27	3	B	Pitched several modification ideas. Scheduled next session.	Course B Brainstorming Document
2021-05-06	3	B	Continued discussion. Resolved to focus on course's final project. Began preparing Course Modification Proposal	Course B Brainstorming Document
2021-05-07	3	A	Walked through changes with instructor to get feedback and iterate. Trained in use of Brightspace in-post video recording feature.	Course A Workspace Document
2021-05-12	3	A	Finished implementation of	

			modifications. Final instructor approval.	
2021-05-25	3	B	Presented draft Modification Proposal. Scheduled next session.	Course B Modification Proposal
2021-06-01	3	B	Finalized Modification Proposal. Set control session student survey date & communication. Began implementing modifications.	Course B Modification Proposal
2021-06-15	3	B	Walked through changes with instructor to get feedback and iterate.	Course B Workspace Document
2021-06-24	3	B	Finished implementation of modifications. Final instructor approval.	
2021-06-24	**3**	**A & B**	**Stage 3 (Course Modification) Complete**	**Stage 3 Folder**
2021-06-28	4	B	Deployed Student Survey in control section	Course B Student Survey
2021-07-08	4	A	Check-in email with instructor just to make sure there are no unforeseen issues.	
2021-08-01	4	A	Deployed Student Survey in treatment section	Course A Student Survey
2021-08-16	4	B	Deployed Student Survey in treatment section	Course B Student Survey
2021-08-28	4	A	Collection of Student Survey & Other Quant Data	Course A Student Data
2021-08-29	4	B	Collection of Student Survey & Other Quant Data	Course B Student Data
2021-09-01	**4**	**A & B**	**Stage 4 Completed Preliminary Student Data Analysis & Student Data**	**Phase 7 Folder**

			Collection Complete	
2021-09-01	5	A	Provided PSDA to Instructor & Scheduled Third Interview for Sept. 13 @ 2pm	Instructor A Interview 3 Cal Event
2021-09-01	5	B	Provided PSDA to Instructor & Scheduled Third Interview for Sept. 20 @ 2pm	Instructor B Interview 3 Cal Event
2021-09-01	6	A&B	Began Quantitative Analysis of Student Data	Student Quant Data Workbook
2021-09-13	5	A	Conducted Third interview	Instructor A Interview 3
2021-09-15	6	A&B	Completed Quantitative Analysis of Student Data	JASP Files
2021-09-20	5	B	Conducted Third interview	Instructor B Interview 3
2021-09-27	5	A&B	All interview transcripts corrected	Interview Coding Workbook
2021-10-01	6	A&B	Transcript annotation complete	Interview Coding Workbook
2021-10-07	6	A&B	Transcript coding complete	Interview Coding Workbook
2021-10-07	6	A&B	Began Coding Qualitative Student Data	Early Student Qual Data Workbook
2021-10-31	6	A&B	Still Coding Student Data	
2021-11-01	6	A	Drafted Instructor A Profile	Chapter 4 Draft - David's Profile
2021-11-17	6	A&B	Student qual data coding not going well. Reviewed seminal UDL sources.	

2021-11-24	6	A&B	Overhauled scheme and began recoding MANY statements.	Current Student Qual Data Workbook
2021-12-01	6	A&B	Coding continues. Began experimenting with visualization options.	Current Student Qual Data Workbook
2021-12-22	6	A&B	Coding mostly complete. "Sanity" checking. Built data dashboard to facilitate analysis and for producing diagrams.	Qual Data Dashboard
2022-01-03	6	B	Drafted Instructor B Profile	Chapter 4 Draft - Kelly's Profile
2022-01-26	6	A&B	Finished Quant sections of Chapter 4. Finding and fixing coding errors in Student Qual data. Making charts, tables and diagrams.	Chapter 4 Draft
2022-02-24	**6**	**A&B**	**Completed Phase 9 (Chapter 4 Draft) after brutal slog.**	**Chapter 4 Draft**
2022-02-26	6	A&B	Major revisions to Chapter 3 to accommodate for coding methods overhaul.	Chapter 3 Draft
2022-03-05	6	A&B	Review and revision of Chapters 1 and 2 in preparation to write Chapter 5.	Dissertation Draft Folder
2022-03-19	6	A&B	Finished revision pass over 1 & 2 and began writing Chapter 5	Chapter 5 Draft
2022-03-30	**6**	**A&B**	**Completed draft of Chapter 5. Formatting tweaks, assembling appendices, checking references, merged chapter drafts, etc.**	**Complete Draft Dissertation**