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Integrating Universal Design For Learning Through Content Video With Preservice Teachers

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INTEGRATING UNIVERSAL DESIGN FOR LEARNING THROUGH CONTENT VIDEO WITH PRESERVICE TEACHERS

by

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ABSTRACT

Given current legislation to ensure education for students with disabilities and that institutions of higher education are required to use universal design for learning (UDL) principles, the purpose of this study was to explore the impact of video modeling on preservice teachers' knowledge, understanding and application of the three principles of UDL. Preservice teachers were randomly assigned to control or experimental groups to determine if video embedded with UDL principles impacted their thinking. Specifically, pre and posttest information of knowledge and understanding as well as self-perceived ability to teach students with disabilities using UDL was analyzed. In addition preservice teacher created lesson plans were analyzed for application of UDL principles after viewing the video intervention. Quantitative analyses were conducted to compare pre and posttest scores of the control group (n = 41) and experimental group (n =45). The quantitative analyses of knowledge, understanding and self-perceived ability to use UDL were mixed. The results of this investigation were consistent with current research that teacher application of a skill requires more than a one-shot intervention.

This dissertation is dedicated to all those who were told they could not accomplish something and did it anyway.

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THE PROBLEM AND ITS CLARIFYING COMPONENTS

Introduction

Elementary teachers need to provide instruction that is designed to meet the needs of all students (Darling-Hammond, 2003). The field of special education currently is advocating that instruction be universally designed to meet a wide range of learners' needs in the general education setting (Hitchcock, Meyer, Rose, & Jackson 2002). Chapter one provides a rationale to address this issue by providing elementary preservice general education teachers instruction in the application of principles of universal design for learning (UDL) in lesson planning (Rose & Meyer, 2000; 2005). The chapter begins with the statement of the problem and a literature review comprised of legislative action that has led to the inclusion of students with disabilities in general education classrooms; and the resulting need for preservice teachers (PTs) to be prepared to develop goals, methods, materials, and assessments for students of varying ability levels. The chapter discussion then moves to the purpose of the study and the application to practice. The chapter concludes with a presentation of the methodology including research questions, design, data analysis, and definitions of terms.

Statement of the Problem

Many developments in the history of special education have led to unforeseen outcomes (Hallahan, Kauggman, & Pullen, 2009). As a result of recent changes to educational legislation, NCLB (2001) and IDEA (2004), have impressed upon educational institutions the importance of including all students in standards-based coursework in the least restrictive environment (LRE). Though data support including all students in general education classes (Gable, Hendrickson, &

Tonelson, 2000), research indicates that many general education preservice teachers (PTs) do not perceive themselves as adequately prepared to provide instruction to students who have disabilities (Kirch et al., 2007; Norman et al., 1998).

A potential solution is for higher education to better prepare all teachers for the range of students they will instruct. Higher education needs to help PTs reconceptualize the process from the teacher being engaged to students being the center of learning by creating multiple pathways for students' success (Bouillion & Gomes, 2001; McGregor, 2004; McGregor & Guner, 2001; Singer, Marx, Krajcik, & Clay-Chambers, 2000). Traditionally teachers have used the lecture-read-group discussion method in conjunction with a textbook to teach content material. These techniques for students with varying learning styles and abilities have not resulted in successful learning outcomes as noted in low graduation rates, high rates of unemployment and underemployment as well as limited post-secondary enrollment for students with disabilities (Horton, Lovitt, & Slocum, 1988). McCoy (2005) suggests that in order to develop and sustain student interest in content areas they need to be engaged in the process avoiding excessive textbook and lecture dependent learning. Unfortunately, according to the Trends in Mathematics and Science Study (TIMSS) data, fourth grade students noted this type of student-centered engaged learning is not occurring (Martin, Mullis, & Foy, 2007). The current findings indicate "the most frequent science investigation activities were writing, giving an explanation, and watching teachers demonstrate a science concept (69%)" (p. 296). In fact, internationally, 52% of fourth grade students noted textbooks as the primary source for science instruction (Martin et al.). These findings indicate a paradigm shift is needed for success of all students and perhaps even more critical for students with disabilities for reasons indicated.

A dramatic shift in teacher preparation and classroom practice needs to occur. The reauthorization of the Higher Education Act (2008) requires the use of UDL principles; multiple means of representation (MMR), multiple means of action and expression (MMAE), and multiple means of engagement (MME) for students with disabilities. One example is that recipients of federal grants relating to teacher preparation must include in the course work "strategies consistent with the principles of UDL" [P.L. 110-315, §300.172(a)(1)] and that preparation program evaluation and performance measures should include UDL (Sopko, 2009).

Since institutions of higher education (IHE) are required to use UDL principles in teacher preparation courses then logic would follow that PTs need to understand how to apply these practices in K-12 education. By applying UDL principles during planning, PTs may consider themselves more equipped to meet the needs of students with varying ability levels. Utilizing UDL in lesson planning requires a movement from teacher-centered classrooms to student-centered. Critical to this shift is PTs thinking about the presentation of academic material in a way that may be very different from how they were taught (Biddle, 2006; Lee et al., 2004). This change for teachers begins with a belief that positive learning outcomes for all students are possible (Haney, Czerniak, & Lumpe, 1996; Haney & McArthur, 2002) and by being prepared by IHE, to serve all students effectively.

Background: Need for Study

Previous generations of general education teachers often did not provide instruction to students with disabilities, and course work related to this population was only provided to special educators. The focus of these special education courses was to find and "fix" the student's problems in an isolated environment restricting access to the general education environment

(Jackson & Harper, 2001). However, society has learned that education cannot "fix" a student as shown by the alarming statistics that 60% of inmates and 75% of unemployed adults are functionally illiterate and at least 33% of mothers on welfare have identified disabilities (Rumberger & Thomas, 2000).

On the other hand, as a result of No Child Left Behind (NCLB, 2001) and the Individuals with Disabilities Education Act (IDEA, 2004), special education is no longer a place for students with disabilities, but rather a system of supports and services allowing greater access to the general education curriculum (Jackson & Harper, 2001). The focus has changed from "fixing" the student to fixing the curriculum to meet the needs of students with varying ability levels. Consequently, general education teachers today are expected to plan lessons with the objective of students with disabilities accessing the general education curriculum (Jackson, Harper, & Jackson, 2001; Rose & Meyer, 2002). In order to accomplish the task of retrofitting the curriculum, general education teachers must reflect on their current practice and decisively explore how to make the learning more flexible for students of varying ability levels (Jackson & Harper).

Preservice teachers are in the process of learning instructional practices and developing their repertoire of lessons and therefore do not need to retrofit curriculum if given the opportunity to design flexible lessons from the start of their preparation program. By IHE building these skills into the PT curriculum this population will be well prepared to teach all students (Lipsky & Gartner, 2004).

Yet, the way general education teachers are currently prepared, and how they design lesson plans has not necessarily changed to account for inclusion of students with disabilities (Lipsky & Gartner). Preservice teachers tend to perceive themselves as lacking the necessary skills to plan

appropriate instruction for students of varying ability levels (Kirch, Bargerhuff, Turner, & Wheatly, 2005; Norman, Caseau, & Stefanich, 1998). In fact, many PTs were themselves not in inclusive classes, a point of reference from modeling effective practices for students with disabilities in many cases is nonexistent (Ingersoll, 2003). However, the quandary remains of how PTs can change self-perceptions and obtain competency in planning instruction that utilizes research-based practices to meet students' various academic needs.

Universal Design for Learning (UDL)

One avenue by which educators can change their practice is by planning for inclusive classrooms through UDL. Universal design for learning is defined by the Center for Applied Special Technology (CAST) as "a framework for designing educational environments that enable all learners to gain knowledge, skills, and enthusiasm for learning… by simultaneously reducing barriers to the curriculum and providing rich supports for learning" (Center for Applied Special Technology [CAST], 2007, n.p.). Instead of having an accommodation for a single student, that accommodation now becomes an option for all learners. The underlying meaning behind UDL is to provide a proactive way of designing curriculum to meet individual learning needs by allowing for optimum content access for all students (Rose & Meyer, 2000). The model is designed for not simply accessing information or activities, but rather as a plan for learning that accounts for the abilities of all learners (Hitchcock et al., 2002). This plan typically consists of the three principles teachers consider as they develop their instruction (CAST, 2008); Principle I: provide multiple means of representation (the "what" of learning); Principle II: provide multiple means of expression (the "how" of learning); and Principle III: provide multiple means of engagement (the "why" of learning) (www.cast.org). By using the three principles of

UDL when writing lesson plans; the goals, methods, materials, and assessments of content are the focus of learning, not student differences. "The three principles of UDL have strong intuitive appeal when applied to the design of curriculum media and materials… [and] also have practical and ethical appeal in that application endeavors to increase instructional effectiveness, and simultaneously extend this effectiveness to all learners" (Jackson & Harper, 2001, p. 7). When educators change their practice by utilizing UDL, they are inherently planning for inclusion.

Purpose of the Study

The purpose of this study is to contribute to the existing field of resources regarding teachers' self-perceptions of competency in planning lessons for students of varying ability levels using UDL. The study explores preparing general education preservice elementary teachers to plan for students of varying ability levels by understanding and applying UDL principles. The unique contribution this study explores is if teaching UDL through video in the content area of science influences the application and perceptions of PTs to meet the needs of a wide range of learners.

Application to Practice

This study attempts to determine the effects of video instruction in UDL on PTs knowledge, perceptions, and lesson development. As a result of learning about UDL in a content area, the researcher hypothesizes that PTs will improve their perceptions for teaching a wide range of learners as well as improve their knowledge and understanding of UDL.

Research Questions

The following research questions were investigated with PT:

1. Does knowledge and comprehension of universal design for learning principles change when taught in context with content?
2. Does preservice teachers' perception about their ability to serve students with disabilities change when provided video intervention with universal design for learning?
3. Does application of universal design for learning principles increase when taught in context with content?

Instrumentation

Two instruments were used for data collection in the study, a researcher designed pre and posttest and a lesson plan evaluation tool. The pre and posttest were used to measure knowledge and understanding of UDL principles as well as PTs' self perceived levels of competency to teach students of varying ability levels using the three principles and nine guidelines of UDL. The lesson plans created by the PTs were used to measure the application of UDL principles.

Pre and Posttest

The pre and posttest (see Appendix A) were developed by the researcher with assistance and use of questions provided by the CAST center. This instrument was developed to examine knowledge/ understanding about UDL and perceptions of competency to teach students of varying ability levels. The pre and posttest consisted of ten sections measuring knowledge and

comprehension of UDL as well as self-perceptions and science content knowledge. Section one of the instrument related to participants' rights as stated in the approval of the Institutional Review Board (IRB) (see Appendix B for IRB approval and Appendix C for consent forms) while section two provided a place for the participant number. To measure PTs knowledge of UDL, section three had twelve multiple-choice questions, and one question where the respondents choose three of nine items provided. Section four had four open-ended questions that measured comprehension of the UDL principles. Additionally, section five consisted of 13 questions rating self confidence of teaching students of varying ability levels on a five-point Likert scale, with one being the lowest perception of competency and five being highest perception of competency. The pretest had the exact same questions as the posttest with four additional questions relating to demographics as section six of the pretest. These four demographic questions were not repeated on the posttest since participant demographics would not have changed during the course of the study. Both the pre and posttest were accessed through surveymonkey.com, an online secure data collection website, or via a paper copy of the survey.

Lesson Plan

Participants were asked to create a standard lesson plan as part of a class assignment (see Appendix D). Specifically, PTs were asked to write a lesson plan including sections for materials, procedures, and assessments using UDL to accommodate students with varying ability levels. The PTs framed their lessons using three tools; a given state standard, the three components of UDL, and the science content from a two-minute Brainpop video used as a component of the study. Data from the lesson plans were analyzed using a 3-point scale rubric (0 = no response, 1 = undeveloped, 2 = partially developed, 3 = fully developed) to determine if

the intervention influenced lesson development (see Appendix E for grading rubric). The largest possible overall score for the lesson plan was 24 and the lowest possible score was zero.

Video Intervention

The intervention was a science content video professionally created by Consumer Aerosol Products Council (CAPCO) (see Appendix F). The control group watched this video in its entirety (approximately 10 minutes). The experimental group also viewed a 10 minute video, however in addition to edited CAPCO footage; the researcher demonstrated how the content video could be utilized in the classroom using UDL principles. The eminence of the video underwent quality control for production, understandability, and content prior to use in the study. The UDL content in the video was validated by researchers in the field as well as by CAST (see Appendix I).

Viewer's Guides

To facilitate learning, and model UDL a viewer's guide was developed by the researcher for each video. Both groups had access to the viewer's guide that was specific to the video observed (see Appendix G and H).

Research Design and Treatment Conditions

The researcher employed a quantitative design for this study. A pilot study was conducted for procedures in the study with a class with one professor. For the actual study, another professor was the primary instructor. Data were then compared from scores on the pre and posttest as well as from the lesson plan instrument. The participants for this study were

preservice elementary education majors enrolled in Elementary Science Methods, SCE 3310. For this research, the four sections of the course were taught by one professor, and PTs were randomly assigned to either a control or experimental group.

Research Timeline and Data Collection Procedures

Subsequent to spring break, preservice elementary education majors enrolled in six sections of EEX 4070, an entirely online course, participated in a pilot for the final study. Originally EEX 4070 students were to participate as a parallel study, however due to the researcher not providing study materials in an intuitive section of the course, technology issues with viewing the intervention videos, and concurrent enrollment in SCE 3310 this course was considered a pilot. As a result of this pilot, the data collection procedures for the study occurred in four sections of SCE 3310 which was an entirely face-to-face course.

The dissertation study commenced during the second week in April when all students, enrolled in SCE 3310 being taught by the same professor. Preservice teachers were randomly assigned to the control or experimental group. During this first week of the study, students were also sent an email from their professor and asked to complete the UDL pretest on surveymonkey.com. The goal of the pretest was to determine the PTs knowledge and understanding of UDL as well as their self-perception of level of preparedness to work with students of varying ability levels.

During week two of the study, the researcher went to each of the SCE 3310 classes to show the respective groups the control or experimental video with assistance from the course instructor. Following the video, the researcher explained the lesson plan assignment as well as the prewriting option that was to be completed during week three of the study (participants did

not have class during week three of the study to complete the lesson plan). Week four was the last day the class met for the semester. At this point, the participants turned in hard copies of their lessons to the SCE 3310 professor and completed the posttest.

Data Analysis

Following data collection, quantitative statistical analyses were completed. Descriptive statistics were gathered from the survey instrument to show demographic information about the PTs.

Prior to data analyses, differences in groups were determined to answer if the pretest had any effect on the outcomes. Since participants had answered the pretest in one of three ways an independent *t* test was conducted to determine whether there was a significant difference in pretest scores. These scores were analyzed to identify any difference in knowledge and understanding of the principles of UDL, under the three different conditions participants took the pretest: (a) Survey taken prior to April 5 (to be known as the early group), (b) Survey was taken after April 12 online, (to be known as the online group), or (c) Survey was taken after April 12 in a paper and pencil format, (to be known as the paper group).

Research question one was answered using the pre and posttest sections about knowledge and comprehension of UDL. The knowledge questions from the pre and post test were examined. The first test was an independent *t* test conducted to evaluate the hypothesis that no statistically significant difference exists in PTs knowledge of UDL principles when taught in context with elementary content. Further examination of the data using paired sample *t* tests was completed to determine if a statistically significant difference existed between the control groups' pre and posttest scores and/or the experimental groups' pre and posttest scores.

Data analyses for the comprehension questions on the pre and posttest were conducted individually for each of the four questions on this section of the instrument. First, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL prior to treatment in the control and experimental groups for each of the four questions. Next, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL after treatment comparing the control and experimental groups for each of the four questions on the posttest. Finally, two dependent *t* tests were performed to determine if a statistically significant difference existed in each the control and experimental groups when comparing pre and posttest scores.

Research question two was answered using the pre and posttest sections about PTs self-perception of ability to serve students with disabilities. Subsequently, an independent *t* test was conducted to evaluate if a statistically significant difference existed in self-perception of competency in teaching students with disabilities on the posttest when comparing the control and experimental groups. Further examination of the data using paired sample *t* tests were completed to determine if a statistically significant difference existed between the control groups' pre and posttest scores and/or the experimental groups' pre and posttest scores.

In order to answer research question three lesson plan scores between the control and experimental groups were analyzed. Three independent *t* tests were conducted. Since the scoring for the lesson plan was completed with two sets of rubrics each having its own composite score, and a final total composite score, three separate *t* tests were ran.

Independent Variable

The independent variable was UDL instruction embedded in science content from the experimental groups' video.

Dependent Variables

One of the dependent variables was the knowledge/ understanding about UDL principles. The second dependent variable was PTs self-perception of competency in teaching students with disabilities. The third dependent variable was the application of the UDL principles in lesson planning.

Definition of Terms

The terms in this study are used with the following acknowledged definitions:

Avatar: is a computer generated representation of the user – in this case a stick figure is used to assist in the technical aspects of UDL in the experimental groups intervention video.

CAST: CAST is the acronym for Center for Applied Special Technology. This organization mirrors the universal design movement in architecture where the needs of the largest number of users is made possible. The founders then created UDL to make academic content accessible to all learners ("About CAST," n.d.).

Digital Natives: The current generation that has grown up with digital media and is accustomed to its daily use.

Exceptionalities: "Physical, mental, or emotional conditions, including gifted/talented abilities, that require individualized instruction and/or other educational support or services" (National Council for Accreditation of Teacher Education [NCATE], 2008, p. 86).

Fairness (professional disposition): “The commitment demonstrated in striving to meet the educational needs of all students in a caring, non-discriminatory, and equitable manner” (NCATE, 2008, p. 86).

General Education: “A classroom setting(s) in which a typical, nondisabled student is instructed” (Wanzenried, 1998, p. 10).

Inclusion: Serving students in the least restrictive environment to meet individual learning needs (Norman, Caseau, & Stefanich, 1998). When inclusion is used in this study, the term refers to heterogeneous classes that include students with disabilities, students who are gifted, as well as students without labels.

Inquiry: “Inquiry is a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge/ understanding and develop a rich understanding of concepts, principles, models, and theories…” (National Science Teachers Association [NSTA], 2003, p. 214).

Knowledge: “Empirical research, disciplined inquiry, informed theory, and the wisdom of practice” (NCATE, 2008, p. 87).

Lesson Planning: “The arrangements used to teach students based on the purpose of the lesson, the nature of the content covered, and the strengths and needs of students” (Salend, 2008, p. 165).

Paradigm shift: A change in thinking.

Pedagogical Content knowledge/ understanding: “The interaction of the subject matter and effective teaching strategies to help students learn the subject matter. It requires a thorough understanding of the content to teach it in multiple ways, drawing on the cultural backgrounds and prior knowledge/ understanding and experiences of students” (NCATE, 2008, p. 89).

Performance assessment: “A comprehensive assessment through which candidates demonstrate their proficiencies in subject, professional, and pedagogical knowledge/ understanding, skills, and professional dispositions, including their abilities to have positive effects on student learning” (NCATE, 2008, p. 87).

Preservice teachers (PTs): “Those students who do not yet have licenses to teach. This group of students consists of undergraduate and alternative licensure students (students with an earned bachelor’s degree returning to earn licensure)” (Annetta & Dotger, 2006, p. 41).

Skills: “The ability to use content, professional, and pedagogical knowledge/ understanding effectively and readily in diverse teaching settings in a manner that ensures that all students are learning” (NCATE, 2008, p. 91).

Textbook-based learning (traditional teaching): These terms will be used interchangeably to describe teachers focusing on isolated facts in textbooks that have condensed and didactic information presented (Lenz, Deshler, & Kissam, 2004).

Universal Design for Learning: Universal design for learning (UDL) means a scientifically valid framework for guiding educational practice that—(A) provides flexibility in the ways students are presented information, respond, engage, or demonstrate knowledge and skills; and (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient. [HEOA, P.L. 110-315, §103(a)(24)].

Varying ability levels: Includes students with disabilities (primarily students with mild to moderate disabilities that have an IEP or 504 Plan under the Rehabilitation Act of 1972), students who are gifted (have special gifts and talents in intellectual ability, focused academic

areas, or the arts), and everyone who does not fit in one of these two categories (Clark & Zimmerman, 1998).

Video modeling: Showing a video example of how to implement the idea being taught with the population for which the desired behaviors are required.

CHAPTER TWO:
REVIEW OF LITERATURE

Introduction

Universal design for learning (UDL) is one method preservice teachers (PTs) may use to create lesson plans that meet the needs of all learners. By creating lesson plans that utilize the principles of UDL, the teacher provides a flexible format while maintaining the integrity of instructional goals, methods, materials, and assessment (Hichcock et al., 2002). The UDL principles emphasize flexibility in content, level, pace, amount and type of knowledge, complexity and sequence allowing PTs to adjust their lessons to meet the needs of all students (Cawley, Foley, & Miller, 2003).

Chapter Overview

This chapter examines the literature congruent with addressing the need for preservice elementary education teachers to move beyond a level of knowledge/ comprehension, to application of UDL planning in the context of science. Initially, the chapter identifies how legislation for inclusion of students with disabilities in the least restrictive environment (LRE) increases the urgency for PTs to use UDL principles. The chapter concludes by providing a potential solution for planning for the academic success of all students through application of UDL principles.

Legislative Impact on Educational Settings

Recent legislation such as No Child Left Behind (NCLB) and the Individuals with Disabilities Education Act (IDEA) has impressed upon educational institutions the importance of including all students in challenging coursework (Lipsky & Gartner, 2004). Specifically, for the

first time in the history of education, students with disabilities are expected to meet state content standards (Yell, Katsiyannas, & Shiner, 2000), yet how best to serve all students is still open for debate.

Least Restrictive Environment

Due to legislative changes students with disabilities are being included in general education classrooms (LRE) at higher proportions than students who continue to be served in more restrictive environments, such as self contained classes (Lipsky & Gartner, 2004). The IDEA language requires:

> To the maximum extent appropriate, children with disabilities, including children in public or private institutions or other care facilities, are educated with children who are not disabled, and special classes, separate schooling, or other removal of children with disabilities from the regular educational environment occurs only when the nature or severity of the disability of a child is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily (IDEA, Title I (B) Sec. 612 (a)(5)(A), 2004).

As an outcome of LRE language, students are spending more time in these general education settings with and without special education support (Cartledge & Loe, 2001; Chard, 2004; Dieker & Murawski, 2003). The IDEA law states that all students should have access to the general education curriculum (1996) in the regular classroom (2004). The models for more inclusive practices (Fitch, 2003) have created environments that guarantee student access while (Lipsky, 2003); "having high expectations for such children and ensuring their access in the

general education curriculum to the maximum extent possible" (IDEA, Sec. 601 [c][5][A], 1997).

These expectations vary in each state. Assessments for how states are held accountable for students with disabilities vary for both NCLB and IDEA as do the percentage of students with disabilities who are included in the general education setting (Lee, Grigg, & Dion, 2007). The IDEA does require, however, assessment of all students no matter the educational setting. According to the National Assessment of Educational Programs (NAEP, 2008), "students with disabilities with different characteristics are included at different rates and the distribution of such characteristics differs across states and across time" (p.5). This unclear picture of service delivery across states leaves a lack of clarity as to whether a student is included based on their needs, the structure of the state, district, or even on a teacher's credentials. The outcome of this unclear picture of inclusive practices across states leads to inconsistency in services and in comparing student outcomes nationally.

Highly Qualified Teachers

Both educational laws, IDEA and NCLB, state that all PTs including special education teachers, must be highly qualified. "Serious disagreements about what it means for teachers to be well qualified and about what it takes to prepare teachers well" still exists (Wilson, Floden, & Ferrini-Mundy, 2001, p.i). The licensure differences across states can contribute to an inconsistent outcome for students with disabilities. Despite IDEA 2004 language stating that teachers must "have the content knowledge and skills to serve children with disabilities" (IDEA, Sec. 300.156, 2004), these specific requirements vary state to state as how this task is accomplished. Nationally three requirements are provided for all PTs to be considered a highly

qualified teacher (HQT): (a) earning a Bachelor's Degree from a college or university; (b) full state certification in the area of instruction; and (c) demonstration of subject matter competence in the area in which teachers will provide instruction (Yell, Drasgow, & Lowrey, 2005). Thus, students who graduate from teacher preparation programs would expect to be highly qualified upon graduation. Yet, according to National Association of State Directors of Teacher Education and Certification (NASDTEC) (2003) new general educators were not considered to be highly qualified in regards to teaching students with disabilities but expected to share responsibility for the success of all learners (Friend, 2000).

Students with Special Needs

Many teachers do not have an understanding of how to support students with special needs in the general education setting even when students are present (Abell & Lederman, 2007; Darling-Hammond, 2003; Kirch et al., 2005; 2007). Norman and colleagues (1998) note that over three-fourths (78.9%) of general education teachers felt the need for specialized preparation to help them overcome prejudices and emotional barriers in working with students with disabilities. Reith and Polsgrove (1998) aptly state, "It is not enough to merely place students with [disabilities] in general class settings without providing appropriate training, materials, and support to them and their teachers. To do so surely invites their failure" (p. 257). Vaughn, Bos, and Schumm (2000) add that this population requires careful planning and decision making when it comes to teaching. Yet, the more overwhelmed a teacher feels about meeting individual needs, the less likely that teacher will support inclusion (Soodak, Podell, & Lehman, 1998). Therefore, research supports a need for stronger preparation of general education teachers (Darling-Hammond, 2003).

Related to teacher preparation, Zirkle and Winegardner (2005) conducted a study in Ohio on a teacher preparation program. They found that the graduates' greatest area of concern was working with special populations. Coombs-Richardson, Al-Juraid, and Stucker (2000) also found a single college course discussing exceptional education was not enough to prepare general education PTs for the challenges associated with the inclusion of students with special needs. "A growing body of evidence indicates that teachers who lack adequate initial preparation are more likely to leave the profession" (Darling- Hammond, 2003, p.7). Hence, teachers need knowledge and tools to move from the understanding of inclusion to positive application with students of varying ability levels.

Technology

One of the tools needed by teachers for successful inclusion of students with varying ability levels is the use of technology in the classroom. Basically, the paradigm in thinking about students with disabilities and technology must shift from using technology only for communication or review to tools that will increase content representation, action and expression of students, and increased engagement in order to meet federal mandates and best educate students.

Current practice indicates that despite the advancement toward HQT and serving students in more inclusive settings, a gap still exists in practice. One reason may be reflected in the limited use of technology in classrooms (National Center for Education Statistics [NCES], 2000). For example, "a teacher who firmly believes that the best way for students to learn content is through informative teacher-delivered lectures will give little consideration to the idea of using technology as means for student exploration" (Judson, 2006 p. 583). Judson goes on to discuss

that fear and attitudes toward technology may result in lessons that are more traditional in style. Smerdon and colleagues (2000) add that the increase in availability of technology in classrooms has increased with little effect on how teachers teach. In fact, NCES found that only half of all teachers who had computers in their classroom used them for instruction. Furthermore, Becker and Ravitz (2001) state that the teachers who have the greatest knowledge of technology use computers more often in their classrooms with only 12% of teachers using multimedia authoring and presentation software. Thus Becker and Ravitz demonstrate that teachers are not using technology in the classroom; even though IDEA (2004) requires access for all students regardless of their ability or diagnosed disability.

The effects for students with disabilities not having access to technology may increase individual gaps in learning in the general education setting (Edyburn, 2006). For example, technology can be used to support academics (problem solving, reading, writing, and mathematics) and assist with memory and organization (Lee & Templeton, 2008). Public Law 100-407 (Technology-Related Assistance Act, United States Congress, 1998) defines assistive technology (AT) as any item or piece of equipment used by a person with a disability to increase, maintain, or improve functional capabilities. Additionally, Lee and Templeton state that "empirical studies consistently show that the use of AT [assistive technology] promotes self-confidence, freedom, independence, and meaningful participation in home, school, and community" (p. 217). Consider as an illustration the fact that students with print based learning disabilities are not the same students as those defined as having a learning disability with audio or video (Rose et al., 2005).

As a result of teachers not using or allowing students access to technology, digital natives are being subjected to a predisposition for school failure (Dickinson, 2008). Dickinson stated

"the process of how we are teaching our 21st-century learners has to be reconsidered" (p. 12). Equally important is that school failure and underperformance of students with disabilities is chronically higher when AT is not utilized (Blackorby & Wagner, 2004). With technology widely available the needs of students at varying ability levels may be considered less challenging. Edyburn (2009) states "UD[L] is proactive instructional design that seeks to build learning environments and instructional materials with [technological] supports (e.g., text that talks, language conversion, cognitive simplification, dictate responses rather than handwrite, alter font size, etc.) that enable all students to achieve the academic standards despite differences" (n.p.).

A paradigm shift must occur in how teachers think about students with disabilities and technology. This shift has to begin at the most basic level of lesson plan development. For example, the mentality that technology is an extension of print-based assumptions and therefore only useful for word processing, calculations, and games (Reinking, Labbo, & McKenna, 2000) must change to allow for multiple means of action and expression as well as to increase student engagement. Meyer and Rose (1998) add "teaching is all about responsiveness, adaptability, and multiple strategies and resources, so the computer's flexibility – rather than one particular feature- is what gives it so much potential as a teaching tool" (p. 83). As the current generation grows with increasing digital formats, teachers need to embrace these new media to enrich and support learning (Jackson, Koziol, & Rudowitz, 2001). Through the impact of technology, and its use with UDL when lesson planning for students of varying ability levels, the outcome will more likely be successful learning experiences.

Teacher Preparation, Planning and Instructional Practice

To meet a wide range of learners, PTs must be provided tools that increase their knowledge and understanding of inclusive environments. These tools should elevate PTs to the next level of thinking, that of application, by allowing teachers to plan lessons with the achievement of all students in mind (Darling-Hammond & McLaughlin, 1995; Pajares, 2002). By allowing beginning teachers to practice application of knowledge, they should be better prepared to meet the needs of students with disabilities (Boe, Shin, & Cook, 2007).

In order for PTs to take their knowledge and understanding to the application level, changes in disposition and practice must occur. A paradigm shift in the way teachers view themselves and their practice must be addressed (Haney & McArthur, 2002; Lee, Hart, Cuevas, & Enders, 2004). Preservice teachers must learn to think about the specific goal of a lesson (Ellis, Deshler, & Schumaker, 1989) and how to assess that goal (Voltz, Sims, Nelson, & Bivens, 2005) using multiple formats (Rose & Meyer, 2002). Each lesson should focus on materials and methods to determine multiple means of representation, expression, and engagement (Rose & Meyer). This type of planning by PTs' can only occur with a paradigm shift in current practice.

Objectives and Procedures

Even if PTs have the correct paradigm for instruction, the outcome must focus on student learning. "Universally designed instructional goals contain the following components; they are clearly stated, observable, measurable, separate from the means and performance criteria, and connected to the curriculum standards" (Jackson et al., 2001, p. 6). Prior to determining student outcomes, required prerequisite skills should be assessed (Ellis et al., 1989). For example, does the ability to write or comprehend text impact the student's ability to meet the lesson objective?

If a student has identified deficits in the minimal competencies for the objective, the PT should evaluate materials and procedures that include non-text supplements. For instance, Mastropieri and Scruggs (1995) pose that students with disabilities are less likely to encounter difficulties with language and literacy demands with a hands-on approach using manipulatives and thematic units. Using a hands-on approach, learning can be broken down into small manageable parts (Brownell & Thomas, 1998). The learning occurs in longer periods of time with content knowledge deeper than with simply reading text. Lessons delivered in activity-based classrooms utilizing tools such as cooperative groups allow for all students, including those with disabilities, to flourish academically and socially (Mastropieri & Scruggs, 1995). In fact, Pedrosa de Jesus, Neri de Souza, Teixeira-Dias, and Watts (2005) argue to promote higher order thinking learners need a social environment to use language, discover concepts, explore books, and investigate through inquiry learning. This paradigm shift in light of NCLB is required to focus on (a) hands-on activities (Amaral, Garrison, & Klentschy, 2002), (b) collaborative groups (Pedrosa de Jesus et al.), and (c) more generalizable then decontextualized content knowledge (Merino & Hammond, 2001; Rodriguez & Bethel, 1983).

Materials

Once objectives and procedures for a lesson have been established, PTs must look at the materials necessary for students of varying ability levels to access the content material (Rose & Meyer, 2005). Here again, a paradigm shift from teacher to student-centered learning and to lessons being universally designed is critical for the 70% of teachers who use textbooks and the 66% who use workbooks (Henke, Chen, & Goldman, 1999). Multiple means of representation

(MMR), could enhance these traditional lessons by incorporating video, audio, demonstration, or hands on activity to make the material more accessible to a wider range of learners.

In most classrooms across the country computers with internet access are present. These computers could be used for reinforcing skills previously taught (i.e. games, calculators, graphing programs, graphic organizers) (Jackson et al., 2001), for introducing new concepts (i.e. web quests, wikis, virtual field trips, electronic simulation/ experiments) (Ertmer et al., 1999; Henke et al., 1999) or for creating assessments (i.e. power point, word processing, movie making) to increase learning outcomes and student engagement.

Assessment of Lessons

To complete a total paradigm shift PTs need to master UDL for assessment. The actual purpose of assessment is to measure the acquisition of specific skills (Voltz et al., 2005). Student ability levels are to be determined while maintaining the integrity of the assessment as it aligns with the objective. Correspondingly, ideas do not have to be expressed in terms of just a standard writing assignment or test but using UDL principles to allow students multiple ways to demonstrate and evaluate learned concepts. Alternate, performance-based evaluation can be originated with reduced written and literacy requirements (Mastropieri et al., 2005) and using oral inquiry (Scruggs & Mastropieri, 2007), portfolios (Henke et al., 1999), or rubrics (Arter & McTighe, 2001).

An example of a learning assessment process PTs could use to meet a diverse population is the 5E Learning Cycle (Scruggs & Mastropieri, 2007). This model follows all components of effective practice and the paradigm shift needed by PTs in planning, delivery, and assessment. The 5E method of planning requires documentation of learning for students with varying ability

levels (Beisenherz & Dantonio, 1996; Colburn & Clough, 1997; Marek & Cavallo, 1997; Marek & Methven, 1991; Musheno & Lawson, 1999). Dieker, Berg, and Jeanpierre (2008) define the 5E learning cycle as a "variation of an evolved model used to deal specifically with developing a robust understanding of science knowledge and concepts" (p. 261). Whereas Everett and Moyer (2007) provide an expanded definition:

> The learning cycle includes five phases, an *engage* that focuses students on a question, an *explore* where that question is investigated, an *explain* where the data from the investigation are analyzed and interpreted, an *extend and apply* where concepts are connected to other concepts as well as to the real world, and finally, an *evaluate* where the understandings are assessed (p. 54).

Using the 5E Learning Cycle of formative assessment; information is gathered, interpreted, and acted upon by the teacher through soliciting, responding, and reacting to student dialogue (Ruiz-Primo & Furtak, 2006). Teachers assist in moving student thinking toward the learning goals through an exchange of ideas during an open channel of communication (Black & William, 1998; Bell & Cowie, 2001; Duchl, 2003; Furtak & Ruiz-Primo, 2005). "The teacher's role becomes less involved in the direct teaching and more involved with modeling, guiding, facilitating, and continually assessing student work: Teachers in inquiry classrooms must constantly adjust levels of instruction to the information gathered by that assessment" (National Research Council, 1999, p. 82).

Video Modeling

Consequently, opportunities should be provided for PTs to have relevant skill application (Kennedy, 1998; Loucks-Horsley, Hewson, Love, & Stilers, 1998) modeled through video.

Although research has shown that in general video is not more effective than being given information (Olson, Olson, & Meader, 1995), this is not the case when the idea being portrayed is intrinsically visual (Carles, 2001) as is the case with teaching. One method that may assist in this shift while diminishing the quandary with coursework pedagogy is by modeling UDL lessons in video.

Video modeling has a solid research base for teaching students with autism social skills (Ayes & Langone, 2005), yet research regarding the use of video modeling in teacher preparation is limited (Dieker et al., 2009). However, Fletcher (1990) found in his meta-analysis that when compared to traditional instruction, there was an average achievement gain of .69 standard deviations when video modeling was used, and McNeil and Nelson (1991) found similar findings in favor of video modeling in their meta-analyses. Furthermore, Langone and Colleagues (1999) found when PTs had video modeling that their ability for understanding and application of the concepts increased. The use of video modeling to demonstrate how to utilize the three principles of UDL in lesson planning is a logical next step.

Why Universal Design for Learning?

As of 2003-04, there were over 6 million students ages 6-21 receiving special education services (US Department of Education [USDOE], 2007). Outcome data for this population has shown that special education alone may not be what is needed in order for students with disabilities to graduate from high school with a regular diploma. Graduation rates for students with disabilities receiving a regular diploma for the 2003-04 school year was only 54.5% with the graduation rate lowest for black non Hispanic students with disabilities (39.1%) and students with emotional disturbance (38.4%) (USDOE). In order to impact learning and overall

graduation for students with disabilities, a drastic change is needed as the current tools of special educators and individualized education plans (IEPs) alone are not working.

One reason these tools may not be working is that IEP's were originally designed for use in self-contained classrooms. Yet, the majority of students with disabilities receive their services in a general education classroom. In fact 48% of students with disabilities on average spend 80% or more of their school day in the general education classroom and another 29% are in general education for at least 40% of the school day (USDOE, 2004). Historically, evidence suggests that "students receiving separate curriculum and instruction actually had less expected of them" (Jackson & Harper, 2001, p. 3) which effected legislation to now require students greater access and therefore accountability to the general education curriculum. Generating access without changing instruction in the general education setting may not be the solution. Students with disabilities were removed from the general education setting because of specific academic or behavioral needs.

Universal design for learning has been proposed as a way to minimize these learning and behavioral barriers while increasing learning opportunities (Rose & Meyer, 2002) to promote this needed change in instructional practices. CAST in 1999 received funding from the U.S. Department of Education's Office of Special Programs for the National Center on Accessing the General Curriculum (NCAC). This funding has targeted curricula, teaching practices and national policy to improve access for students with disabilities in the general education curriculum. One of the significant outcomes of NCAC was the establishment of the National Instructional Materials Accessibility Standard (NIMAS) which was incorporated into IDEA (2004) to ensure production and electronic distribution of materials that are accessible to students

with disabilities. Some examples of electronic materials include digital text, images, audio, video, multimedia as well as network environments (Jackson & Harper, 2001).

Correspondingly, technology used to promote the three principles of UDL has been shown to increase positive attitudes of students towards learning (Protheroe, 2005). King-Sears (2001) contends that general education curriculum can be designed for maximum accessibility using technology. Rose and Meyer (2002) explain "barriers to learning occur in the interaction with the curriculum—they are not inherent solely in the capacity of the learner, thus, when education fails, the curriculum, not the learner, should take the responsibility for adaptation" (p. 20). If 45.5% of all students with disabilities have a learning disability, having curriculum UDL with appropriate uses of technology is critical for success in the general education classroom.

Universal Design for Learning

Universal design for learning provides a tool to support PT change and success in the general education setting. The concepts of UDL appear deceptively simple, yet repeated exposure, practice, and feedback are required for mastery (Rose & Meyer, 2002). Knowledge and comprehension of the concepts is very different from consistent application in real classrooms. This section provides a general overview of the three main principles of UDL; multiple means of representation, expression, and engagement, as well as how each principle can be used in PT lesson planning. Specific research-based practices are discussed within each of the three broader topics.

UDL Principles and Overarching Concepts

The three main principles of UDL as defined by CAST (2008) are;

> Principle I: provide multiple means of representation (the "what" of learning);
>
> Principle II: provide multiple means of expression (the "how" of learning); and
>
> Principle III: provide multiple means of engagement (the "why" of learning) (www.cast.org).

Utilizing the principles of UDL allows PTs to address varying student abilities by means of building accommodations and student choices into each lesson. By meeting students' needs during the planning stage of lesson development (as opposed to revising when an accommodation must be met) allows for the maximum number of students to benefit from instruction without the need to retrofit each lesson taught (Okwis & McLane, 1998).

According to the UDL Guidelines 1.0 (CAST, 2008) "information that is not attended to, that does not engage student's cognition, is in fact inaccessible" (p. 24). With that being said, simply because a general education curriculum is not well designed for maximum accessibility does not mean that the content is unattainable (King-Sears, 2005). Rose and Meyer (2002) further explain "barriers to learning occur in the interaction with the curriculum - they are not inherent solely in the capacity of the learner, thus, when education fails, the curriculum, not the learner, should take the responsibility for adaptation" (p. 20). The act of allowing options for physical actions, expressive fluency, and executive functions permits directing students' energy toward learning, not simply attempting to access content.

Universal design for learning does not simply allow access to information or activities, but rather facilitates a teacher-made plan for learning to be accessible to all (Hitchcock et al., 2002). Likewise, when planning objectives, methods, materials and assessments in lessons; PTs should

utilize research-based practices thereby diminishing curriculum barriers (Meo, 2008; Rose, Meyer, & Hitchcock, 2005). The three principles and nine guidelines of UDL are necessary for PTs to understand as are examples of supporting research-based practices and plans for learning from both a pedagogical or technological stance.

Principle I: Multiple Means of Representation

According to Soukup, Wehmeyer, Badhinski, and Bovaird (2007), curriculum adaptations in representation of content are accomplished through either pedagogical means or with the assistance of technology. By teachers utilizing multiple means of representation (MMR) and by "planning curriculum and instruction at the outset- with the widest possible range of students in mind- has the potential of reducing the time, costs and efforts associated with designing a highly quality educational program for all students, especially those with disabilities" (Jackson, 2004, p. 3). Principle I is segregated into three separate guidelines (see Table 1) that provide options for: (1) perception, (2) language and symbols, and (3) comprehension all of which "transform static curriculum resources into flexible digital media and tools" (Jackson, p. 3).

Table 1: Multiple means of representation

Provide options for perception	Provide options for language and symbols	Provide options for comprehension
Customize the display of information	Define vocab and symbols	Activate background knowledge
Provide alternatives for auditory information	Decode text or mathematical notations	Highlight critical features, big ideas, and relationships
Provide alternatives for visual information	Promote cross-linguistic understanding	Guide information processing
	Illustrate key concepts	Support memory transfer

Note - Adapted from CAST

Guideline 1: Provide Options for Perception

One way to create a lesson that addresses MMR is by providing options for students to perceive information presented in the classroom. In order to provide students with options for perception, lesson plans are customized to display information, provide alternatives for auditory information, and provide alternatives of visual information (Rose & Strangman, 2007). The goal of MMR is to utilize multiple sensory modalities allowing students to process information in multiple ways (Strangman & Dalton, 2005). Two avenues often pursued in MMR are changing displays of information and providing alternative formats for visual information.

Customizing the display of information is one accommodation for PTs to examine during lesson planning. Altering the size, color, contrast, loudness, speed, and layout of displayed information are all simple ways to allow students to perceive information in a more comfortable format (Csikszentmihalyi, Rathunde, & Whalen, 1993; Tomlinson et al., 2003).

Accommodations to visual information are created with ease using a computer or copy machine (Michael & Trezek, 2006). For example, lab sheets are typed in larger fonts if a student has difficulty with small print.

Providing alternatives for auditory and visual information is a little more challenging for the PTs and requires some advanced planning. When purchasing DVD's or computer games, schools should ensure copies are closed-captioned. If this option is not available, many school districts can add captioning. Correspondingly, additional access to visual information should be provided by oral or tactile modes. Digital textbooks (audio or computer-based) also provide additional modalities for accessing text (Munk, Bruckert, Call, Strehrmann, & Radandt, 1998; Rose & Dalton, 2007). In most cases, Guideline 1 is accomplished through use of technological means rather than pedagogical ones.

Guideline 2: Provide Options for Language and Symbols

Another way to create plans with MMR is by providing options for language and symbols. This guideline consists of five areas to consider with the overall objective being accessibility and ease of understanding of the material presented. The five areas are: (a) options that define vocabulary and symbols, (b) clarify syntax and structure, (c) decode text and mathematical notation, (d) promote cross-linguistic understanding, and (e) illustrate key concepts non-linguistically (CAST, 2008).

One method to address these five areas is to have definitions for unknown words available either through technology, or through pedagogy; including access to a dictionary, a word list, word wall, or translated into the students' native language. Furthermore, having picture representations of words or ideas, making the new ideas connect to prior knowledge, watching a video, observing demonstrations, assembling models, or creating charts are ways to assist

learners who have difficulty with language and symbols and can be accomplished with or without technological means. In most cases, Guideline 2 is accomplished through use of pedagogical means rather than technological ones.

Guideline 3: Provide Options for Comprehension

The third way to incorporate MMR is by providing options for comprehension. Some examples include, providing or activating background knowledge; highlighting critical features, big ideas and relationships; guiding information processing and supporting memory and transfer of knowledge. "The purpose of education is not to make information accessible (that is the purpose of libraries), but to teach students how to transform accessible information into useable knowledge" (CAST, 2008, p.15). Preservice teachers need to use valid tools to assist students in the critical skills of comprehension. The use of mnemonics and graphic organizers are two recognized research-based practices that assist in transforming information into usable knowledge (Meo, 2008).

Mnemonics

Mnemonics can be described as a process that uses current knowledge to improve memory by verbal and visual cues including keywords, pegwords (rhyming), and acronyms. These tools allow recall of information at a later date while understanding the content (Access Center, 2005). Mnemonics are useful for students who may have learning or intellectual disabilities, difficulty with decoding, organizational skills, memory problems, abstract problems, or recall of information (Access Center; Mastropieri, Scruggs, & Levin, 1986; Scruggs, Mastropieri, McLoone, Levin, & Morrison, 1987). This strategy makes information concrete by adding meaningful connections. Munk and colleagues (1998) suggest using a keyword that sounds

similar to something the student already knows to help remember a definition. Whereas Atkinson (1975) proposes using a two part mnemonic key word method, the acoustical and then imagery.

Mastropieri and colleagues (1985) studied the mnemonic key word strategy with ninety 9th graders with learning disabilities. The students were from various high schools in a southwest community and were first divided by reading comprehension percentiles into two groups, (lower n=45 and higher n=45) achievement in reading. From each group of 45 students, 15 were randomly put into one of three groups; pegword method, teacher questioning, or free study. Based on data analysis using Dunn's multiple comparison procedure for main effects and with reading level, the students in the mnemonic group statistically outperformed the other two groups (75.2% compared to 27.8% in the teacher-questioning group and 36.2% in the free study group). In a like manner, a meta analysis of 11 studies conducted using content enhancement (Gajria, Jitendrea, Sood, & Sacks, 2007) where three of the studies (Brigham, Scruggs, & Mastropieri, 1995; Mastropieri et al., 1986; Scruggs et al., 1987) showed mnemonic illustrations with a positive effect size in science (mean ES = 1.19, SD = .53, n = 3) (Gajria et al.).

In addition to mnemonics helping students remember information, this strategy is also useful for PTs to remember teaching strategies. Scruggs and Mastropieri created a mnemonic device to help teachers that have students with disabilities in their classrooms remember important aspects about designing curriculum to meet the needs of all learners. Each letter in the word PASS referred to a specific step teachers need to take in relation to instructional design. In an interview with Mastropieri in 1998 she described PASS as follows:

> *P* stands for *Priorities* for students with disabilities. Teachers need to consider the main objectives they want students with disabilities to accomplish and prioritize those objectives. For instance, do they want all students to learn to use a

> microscope, a difficult task for students with coordination problems, or just see the image in the microscope? [The letter] *A* represents *Adapt*. Teachers have to ask themselves how they can adapt the content, the environment, or their instructional procedures so students can learn prioritized objectives. The first *S* stands for another acronym SCREAM (i e., *Structure, Clarity, Redundancy, Enthusiasm, Appropriate* rate or pace, and *Maximize* student engagement). SCREAM helps prompt teachers to consider effective instruction techniques. Finally, the last *S* represents *Systematic Evaluation*. Unfortunately, many activities-based approaches are not strong in evaluation. Special education professionals need to design performance-based assessments (i.e., simulation activities that are similar to those completed in science instruction) to determine if students with disabilities are learning the intended objectives (Brownell & Thomas, 1998, p.121).

As a result of using the PASS mnemonic device, PTs have a way to remember important aspects about curriculum design to meet the needs of all learners.

Graphic Organizers

Graphic organizers are a second popular nontechnical support for representing information in alternative formats (Bos & Vaughn, 2002; Jackson & Harper, 2005; Strangman, Hall, & Meyer, 2003). Originally called structured overviews then advance organizers (Ausubel, 1960, 1963; Ausubel & Anderson, 1965), the initial designs were for assimilating information effectively. By having a graphic organizer of important content, the information can be arranged in a frame of reference that may be more easily memorized (DiCecco & Gleason, 2002), used as a study guide or reference sheet (Jarrett, 1999; Lovitt & Horton, 1994).

In a study by Darch and Eaves (1986), 22 high school students (grades nine, ten, and eleven) from the southeast with learning disabilities were randomly placed into a group that had instruction with a visually displayed graphic organizer (n = 11) or in a group that used a basal approach to the text (n = 11). Both groups were taught three science units; planets, sun, and meteors with comets. The group with the graphic organizer outperformed the basal group on three unit tests (see Table 2). Statistically, the groups mean for all of the unit tests for the visual display group was 83% correct compared to 57% for the text group.

Table 2: Outcomes of Darch and Eaves (1986)

	Visually displayed graphic organizer	Basal approach to text
Unit test 1	(M = 4.5, SD = .67)	(M = 2.1, SD = 1.3)
Unit test 2	(M = 4.2, SD = .72)	(M = 3.7, SD = 1.1)
Unit test 3	(M = 4.6, SD = .41)	(M = 3.3, SD = 1.7)

The curriculum adaptations in Guideline 3 are accomplished through both pedagogical means and with the assistance of technology. For example, providing or activating background knowledge can occur through traditional teaching, showing a video, or presenting a graphic. Big ideas and relationships; guiding information processing and supporting memory and transfer of knowledge can be accomplished with traditional pedagogy or technology. For instance, blogs provide a place to write that encourages discussion of ideas, feedback, active participation while having the luxury of immediacy in a brief targeted set of words (Kajder & Bull, 2003). Graphic organizers can be created with pencil and paper or with technology such as SmartArt in Microsoft Word or with specialized software like Inspiration to include pictures to enhance memory and transfer of knowledge.

Overall, Principle I of UDL, multiple means of representation (MMR) emphasizes PTs finding ways to make content accessible through use of visual, auditory, technology, or printed means. When technology is the basis for MMR, the tool used must be a good fit for students and the classroom as a whole. When a PT incorporates the three guidelines of principle I into lesson planning, content displayed should be accessible to most learning modalities.

Principle II: Multiple Means for Action and Expression

A second component of planning PTs need to consider, when creating a paradigm shift from teacher to student-centered learning and making lessons UDL, is multiple means for action and expression (MMAE). Many standardized tests of content require higher order thinking skills and using technology students can generate authentic products. Multiple means for action and expression is why "the more educators integrate technology into the core curriculum, the more opportunities for genuine learning they create for students with disabilities. Digital content and tools in a virtual world remove or make more manageable many barriers imposed on the student by physical books, libraries, and laboratories" (Jackson, 2004, p. 16).

Principle II is broken down into guidelines four through six (see Table 3) and provides PTs options for; (4) physical actions, (5) expressive skills and fluency and (6) executive functions (CAST, 2008). Research-based practices related to MMAE include; scaffolding instruction, using computer assisted instruction (CAI), and utilizing formative assessment.

Table 3: Multiple means of action and expression

Provide options for physical actions	Provide options for expressive skills and fluency	Provide options for executive functions
Varied ways to respond Varied ways to interact with materials	Media for communication Appropriate tools for composition and problem solving	Guide effective goal setting Support planning and strategy development
Integrate assistive technologies	Ways to scaffold practice and performance	Facilitate managing information and resources Enhance capacity for monitoring progress

Note - Adapted from CAST

Guideline 4: Provide Options for Physical Actions

One way to create a lesson that addresses MMAE is by providing options for physical actions. The first guideline in UDL Principle II (guideline four) is access for students with physical disabilities. Options for physical response, for instance if a student is unable to put his/her hand in the air, write, or use a mouse, are important for PTs to remember. Students should have options in the means of navigating the lesson by using not only one's hands to perform an action, but buttons, switches, joysticks, or keyboards when necessary. Another component of providing physical action is to have options for accessing tools and assistive technologies. Having keyboard commands for mouse actions allows someone who is unable to use a mouse to utilize the functions of the mouse or having a microscope connected to a computer allowing for variable magnification of specimens are examples of MMAE (CAST,

2008). In many cases, guideline four is one element that does not need to be in every lesson plan because once the equipment is accessible for student use; the only future requirement is to assure the equipment continues to be operational.

Guideline 5: Provide Options for Expressive Skills and Fluency

Another way to construct lessons with MMAE is by providing options for PTs in expressive skills and fluency. The three targeted areas for MMAE are; media for communication, tools for composition and problem solving, and scaffolds for practice and performance (CAST, 2008). Communication and expression of ideas between people is an area often forgotten by PTs in the evaluation portion of the lesson plan. For example, if the evaluation of learning from a science lesson is *the student will write a two-page lab report* some students may not be able to express what has been learned. As a result of limiting expression to only the written form, students who are unable to write cannot complete the evaluation process, regardless of content knowledge. A choice of expressive media for communication permits the exchange of ideas in a variety of formats including drawing, manipulatives, speech, or video in addition to the traditional text.

Providing contemporary tools for composition and problem solving maybe an area that PTs typically do not consider. The school environment is the only place where tools to assist in completion of a task have historically not been allowed. For example, in the work place, spellcheckers, calculators, outlining tools, and speech to text software are commonplace (Tabak & Baumgartner, 2004). Unless the lesson at hand is for the purpose of learning a specific skill that one of these tools uses (i.e. spelling for a spelling test) tools should be available to those students who want to use them. The National Science Education Standards (National Research Council, 1996) specifically expresses that students must utilize science content in real-life

situations. Therefore, students should have access and be able to maneuver tools commonly used outside of classroom confines (i.e., for measuring, estimation, calculating, typing).

The third and final section of guideline five, providing multiple options to scaffold practice and performance, is one of the reasons that UDL is effective with students of varying abilities. For students who need more support, scaffolds are accessible, such as in procedural checklists, samples, templates, and outlines. Yet, students who do not need these tools can forge on with focused learning. Students' needs are met via an array of resources to support interests, academic levels, and prior knowledge (Kulik & Kulik, 1991; Lou et al., 1996). By scaffolding information, the PTs can lead students toward their innate curiosity.

The findings of Kardash and Wallace (2001) lend further support to the use of scaffolding and differentiated instruction. A test of 922 science students, enrolled in various science classes at the college level, was completed over the course of three semesters. The 80-question test had a Likert scale of one to six, with 1 being strongly disagree and 6 being strongly agree. After discarding 12 questions for low or negative item correlations, the data were analyzed using a series of ANOVAs. The overall conclusion from the study is that the majority of students reported ($M = 2.81$) that "science classes remain primarily lecture driven and focused on the acquisition of facts" (p. 208) showing the need for providing options for expressive skills and fluency.

Guideline 6: Provide Options for Executive Functions

A third way to address MMAE is by providing options for executive functions which are when students are supported for planning, strategy development and goal setting. The four subparts of guideline six are providing effective goal setting, planning and strategy development, facilitating information and resource management, and finally, enhancing progress monitoring

capacity (CAST, 2008). The first and second parts reveal information about effective goal setting and support planning and strategy development in relation to the goals. Facilitating and managing information and resources further supports these goals. The final part of this guideline is for PTs to enhance capacity for monitoring progress through formative assessment.

In order to provide options for executive function (higher-level scaffolding), students must first have options that guide effective goal setting. Many times students set goals for themselves that are unrealistic or unobtainable. By having goals that are reasonable and challenging, the scaffolding (Swanson, 1999) of learning is taken to the next level. Through strategy development, students must complete a plan to solve the problem at hand. Cornelius and Herrenkohl (2004) add that scaffolding generates an environment that facilitates communication in various instructional strategies while students are creating their own learning goals leading to meaningful questions and answers in inquiry-based learning.

Options that facilitate managing information and resources are the ways teachers assist students in organizing knowledge. Computer-assisted instruction is considered a promising practice for learners seeking organizational skills (Lahm, 1996). Computer-assisted instruction has been shown to help students with minimal organizational strategies as well as strengthens weak problem solving skills. The computer provides one-on-one instruction requiring students to have high levels of interaction and active learning (Lahm) which in turn may be a motivator to the student (Hitchcock & Noonan, 2000). Likewise, CAI builds on previously-mastered academic skills while increasing wait time (Hitchcock & Noonan; Zimmerman, 1998).

Formative assessments provides options for monitoring progress. The primary goal of formative assessment is an evaluation for learning (Black & Harrison, 2001; Black & Wiliam, 1998). Effective formative assessment improves student understanding by giving ongoing

feedback (Bell & Cowie, 2001; Duschl, 2003). Formative assessment provides a variety of methods for frequent checks of content understanding (Shepard, 2003). However, a challenge to formative assessment is balancing students' current levels of understanding while encouraging higher order thinking (Ruiz- Primo & Furtak, 2006). Hence, MMAE is necessary to ensure multi dimensional assessments of programs beyond monitoring.

Yoon and Onchwari, (2006) declare that one result of formative questioning is the validation of the students' responses while promoting collaborative learning. Some examples of formative questions from Ruiz-Primo and Furtak (2006) include: "Why do you think so?" or "What does that mean?" (p. 216). These types of questions allow a student to express ideas at his/her current level of understanding. Feedback in this manner not only assists the orating student, but also provides a foundational starting point for other students (Sadler, 1989; 1998). Modeling of questioning and comparing is especially important to students with learning disabilities who frequently depend upon cues from the teacher or other students when asked an open ended question, as opposed to figuring out the task at hand (Scruggs & Mastropieri, 1993).

The process of discussion in formative assessment is essential for PTs to incorporate in planning for inquiry-based lessons. "Taking an inquiry approach to informational texts helps students learn to question and be critical of texts rather than to always defer to the text or use texts simply for finding answers" (Hapgood & Palincsar, 2006, p. 59). Ultimately, by students utilizing multiple means for action and expression including, CAI (Lahm, 1996), strategy development (Cornelius & Herrenkohl, 2004), contemporary tools (Cornelius & Herrenkohl), and assessing prior knowledge (Rigden, 1999), students are using a variety of functional literacy skills (Hapgood & Palincsar, 2006) to express higher order thinking concepts that are often not measured by summative assessment tools.

Overall, the research shows that students' understanding of science concepts increases as a direct result of hands-on lessons, inquiry-based learning, and student directed discussions (Coombs-Richardson et al., 2000; Kimmel, Deek, O'Shea, & Farrell, 1999). At the same time, the research has also acknowledged that 96% of questions in the classroom are teacher-generated (Graesser & Person, 1994). Therefore, PTs need to learn how to apply the skills of formative assessment, including questioning early in their teaching.

In summation of Principle II, the critical action of providing MMAE and expression is necessary at the planning stage (Wehmeyer, Hughes, Agran, Garner, & Yeager, 2003). Preservice teachers must realize their role is not to change the student with special needs to be like everyone else, but change the goals, methods, materials and assessments used in instruction so all students have access to the curriculum. Technology can be an avenue for acquiring content and expressing mastered skills.

Principle III: Multiple Means for Engagement

The final principle related to creating the paradigm shift for students with disabilities to be successful in PTs classrooms is multiple means for engagement (MME). There are different motivators for students to learn and what may work for one student may cause disengagement by others (Rose & Meyer, 2005). This principle contains guidelines seven through nine (see Table 4), providing options for recruiting interest, sustaining effort and persistence, and self-regulation (CAST, 2008). Teacher questioning, cooperative learning, peer assisted learning strategies (PALS), and positive behavior supports plans (PBSP) are all research-based practices referenced in MME.

Table 4: Multiple means for engagement

Provide options for recruiting interest	Provide options for sustaining effort and persistence	Provide options for self-regulation
Increase individual choice and autonomy Enhance relevance, value, and authenticity Reduce threats and distractions	Heighten salience of goals and objectives Vary levels of challenge and support Foster collaboration and communication Increase mastery-oriented feedback	Guide personal goal setting and expectations Scaffold coping skills and strategies Develop self-assessment and reflection

Note - Adapted from CAST

Guideline 7: Provide Options for Recruiting Interest

Addressing MME in lessons is accomplished by providing options for recruiting interest. According to Rose and Meyer (2005) information is considered inaccessible when it does not engage student's cognition. When PTs provide options that allow for increasing individual choice and autonomy by providing evidence of relevance as well as valuing authenticity, students are more engaged in learning (Odom, Stoddard, & LaNasa, 2007). Nevertheless, the PT should reduce student perceived threats and distractions for students to feel safe to share opinions and preferences.

Preservice teachers questioning is categorized as either inquiry-based or text-driven when it comes to student learning. Harlow and Otero (2007) define the two types of questioning as productive and unproductive, respectively. Specifically, "productive questions are those which

lead to scientific activities such as observing, describing and explaining observations while unproductive questions lead students to looking for answers in books or from their teacher" (p. 73). Inquiry oriented questioning often facilitates thinking and learning through the art of discovery. In order to reach the higher cognitive levels that those skills require, PTs should be obliged to challenge students with multilevel questions (Morge, 2005; Rakow & Bell, 1998). Additionally, when teachers act as a facilitator (Morge), as opposed to the knowledge source from which the students must learn, student interest is generated. Rop (2003) contributes "because inquiry always involves asking good questions, a good test for a modern curriculum is whether it enables students to see how knowledge grows out of thoughtful questions" (p. 32). Teachers facilitating with productive questioning promotes student curiosity and in turn provides options for increased autonomy and enhanced personal relevance; all important in UDL.

Another aspect of guideline seven, recruiting for interest, involves reducing threats and distraction from the learning environment, including those associated with answering questions. The research indicates many different reasons why students may not want to respond to or ask a question including feeling vulnerable (Maskill & Pedrosa de Jesus, 1997), having questions obstructed because of time, (Marchbab-Ad & Sokolove, 2000), lacking prior knowledge to begin the questioning process (Royce & Holzer, 2003), or asking another student for assistance rather than asking an authoritative figure (Dillion, 1988).

Graesser and Olde (2003) state that "questions are asked when individuals are confronted with obstacles to goals, anomalous events, contradictions, discrepancies, salient contrasts, obvious gaps in knowledge, expectation violations, and decisions that require discrimination among equally attractive alternatives" (p. 525). This definition describes the thinking process that one must go through during inquiry. Therefore, a major predictor of student response

success during inquiry is determined by an atmosphere that encourages and supports student-generated questions (Pedrosa de Jesus, Almeida, & Teixerira-Dias, 2007). Overall, this guideline emphasizes the need for PTs to know how to apply good questioning techniques to meet a range of learner needs.

Guideline 8: Provide Options for Sustaining Effort and Persistence

Another way to incorporate MME into lessons is by sustaining effort and persistence. Guideline 8 is accomplished by heightening salience of goals and objectives, varying levels of challenge and support, fostering collaboration and communication, and increasing mastery-oriented feedback (CAST, 2008). All four can be accomplished with various forms of cooperative learning and grouping. Specifically, academic gains are shown from both peer tutoring and collaborative problem solving (Fawcett & Garton, 2005; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003; Roseth, Johnson, & Johnson, 2008). The practice of allowing construction of knowledge within a group through collaborative discussion permits students to generate justifications of ideas in a safe setting, contributing to the shaping of more active learners (Ash, 2004; Souvignier & Kronenberg, 2007). Similarly, cognitive elaboration perspective suggests that students rephrasing information with the incorporation of examples from one's own prior knowledge enhances the learning in cooperative settings (Rohrbeck et al., 2003). In fact, Pedrosa de Jesus and colleagues (2005) argue "inquiry-based group work is one of the most important learning experiences because it enables the exploration of theoretical ideas and conceptual change" (p. 179).

Mastropieri et al. (2006) provide an example of the richness of cooperative learning and grouping in inquiry. These authors compared thirteen classes (with each teacher having at least one class in each the control and experimental groups) consisting of 213 8th grade science

students with 44 having identified disabilities. At the conclusion of 12-week field trials, the experimental group which received differentiated, peer mediated, hands-on instruction scored statistically higher on both posttests ($F (1192) = 8.93$, $p = .003$) and state high stakes tests ($F (1185) = 5.56$, $p = .018$) as compared to the control group that had traditional science instruction.

Another tool teachers could include in lesson plans is peer-assisted learning strategies (PALS). This form of cooperative learning facilitates students who have difficulty with abstract ideas, decoding or comprehending text. Peer-assisted learning strategies are approved by the USDOE Program Effectiveness Panel for Inclusion in the National Diffusion Network on effective educational practices (John F. Kennedy Center for Research on Human Development, 1999). According to two separate meta-analyses of PALS interventions with elementary school students, this strategy promotes social interaction between peers. The first meta-analysis (Rohrbeck et al., 2003) of 90 studies produced positive effect sizes (ES, $d = .33$, $p < .0001$, 95% confidence interval = .29 - .37). The second meta-analysis (Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006) followed all of the same protocol of Rohrbeck and colleague's meta-analysis with the exception of only including studies that had non-academic outcomes, resulting in 36 studies ($n = 36$), including 26 of the studies identified in the first meta-analysis. The overall effect size for student social skills outcomes (ES =.52, SD = .58) with nearly half a standard deviation higher on student self-concept then peers in the control group (ES = .4, SD = .51) of differing ability levels while focusing on content material (Ashwin, 2002).

As a general rule, students become actively engaged when learning involves interactions with others (Briscoe & Prayaga, 2004; Gijlers & De Jong, 2005). Roseth, Johnson, and Johnson (2008) emphasize the need to sustain effort and persistence in engagement of content. Their article on collaborative learning "suggests that the more early adolescents' teachers structure

students' academic goals cooperatively (as opposed to competitively or individualistically), (a) the more students will tend to achieve, (b) the more positive students' relationships will tend to be, and (c) the more higher levels of achievement will be associated with more positive peer relationships" (p. 238). In essence, environmental controls that motivate student attention for sustaining effort are important to learn self-regulation skills.

Guideline 9: Provide Options for Self-regulation

A third way to integrate MME in lessons is by providing options for intrinsic abilities for self regulation which can be accomplished with personal goal setting, scaffolding of coping skills, as well as developing self assessment for reflection. Guideline nine is focused on a student's intrinsic abilities to self regulate and therefore would not necessarily be part of lesson planning. However, since this is a guideline in UDL, a brief discussion of relevant research is provided.

One research-based practice to assist students with noncompliant behaviors, weak problem solving skills, or lack of attention, is to work with the student to create a functional behavioral assessment (FBA) leading to a positive behavior support plan (PBSP). The 22nd Annual Report to Congress recommended FBAs and PBSPs to meet specific students' needs (Office of Special Education Programs [OSEP], 2000; Miller, Tansy, & Hughes, 1998; Miller, 2001). These supports can be in any of multiple forms of representation. Options PTs include in lesson plans, that scaffold coping skills and develop self-assessment and reflection strategies, can provide the foundation necessary for academic success (Miller).

Summary

Creating a climate for PTs to use UDL may call for a paradigm shift in ideology. The student characteristics addressed with the principles of UDL include student readiness, prior knowledge, interests, learning style, and grouping all of which a PT must apply in practice. In the same manner, incorporating the UDL principles allows students to access content in an array of modalities while learning at their individual levels. Prior qualitative and meta-analysis research has concluded that when materials are differentiated, academic gains increase (Kulik & Kulik, 1991; Lou et al., 1996) and student outcomes are higher in differentiated classrooms compared to classes that are not differentiated (Csikszentmihalyi, Rathunde, & Whalen, 1993; Tomlinson et al., 2003). Ultimately, UDL encompasses "the general concepts, theories, and research about effective teaching, regardless of content areas" (NCATE, 2008, p. 89). Three possible solutions are a paradigm shift in current practice, improving preservice teacher preparation and ensuring the utilization of universal design for learning including technological innovations. Therefore, having university teacher preparation courses model universally designed strategies may facilitate the needed shift in PTs lesson plans to embrace a classroom of diverse learners without the frustration of retrofitting instruction.

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this study was to examine preservice teachers' (PTs) perception of competency, as well as application, of the principles of universal design of learning (UDL) in lesson planning for students with varying ability levels. This chapter is separated into six sections beginning with the research questions, followed by information on the pilot study. Next, a description of the participants, the setting and the instruments used in the study are described including the videos used for the control and experimental groups. Thereafter, a discussion of the design is presented. The chapter concludes with data analyses procedures.

Research Questions

The following research questions were investigated with preservice teachers:

1. Does knowledge and comprehension of universal design for learning principles increase when taught in context with elementary content?
2. Does preservice teachers' self-perception of ability to serve students with disabilities change when provided a video intervention showing universal design for learning?
3. Does application of universal design for learning principles increase when taught in context with elementary content?

Null Hypothesis 1:

No statistically significant difference exists in PTs knowledge and comprehension of UDL principles when taught in context with elementary content.

Null Hypothesis 2:

No statistically significant difference exists in self-perception of competency in teaching students with disabilities when taught UDL principles using a video intervention.

Null Hypothesis 3:

No statistically significant difference is evident in PTs application of UDL when taught in context with elementary science content.

Pilot Study

The original plan was to have a parallel study with PTs enrolled in EEX 4070, an introduction to exceptional education, and SCE 3310, science methods for elementary teachers, to determine if the class in which the student was enrolled impacted student outcomes. The researcher hypothesized that due to differences in how the classes were taught that there would be significantly different gains between the two groups. The SCE 3310 classes had four sections all taught face-to-face in the traditional text based lecture style class with hands on portions for the science labs. The pilot classes, EEX 4070, had six sections all using the same modules and were entirely web-based. The classes were both synchronous and asynchronous with all assignments having options for completion following the principles of UDL. The professor taught each lesson

modeling MMR, MMAE, and MME. Universal design for learning was also addressed in one of the assignments for which students had to adapt one lesson plan found online to include UDL.

The hypothesis was that students enrolled in EEX 4070 would already have knowledge and understanding of UDL due to the way their class was being taught on the pretest, but that the experimental group's application in lesson planning would be higher than the students in SCE 3310. The second hypothesis was that the students in SCE 3310 would increase knowledge, understanding and application of UDL based on the experimental intervention.

Due to professor preferences, EEX 4070 began the study three weeks prior to SCE 3310. The researcher pursued the following protocol. In Webcourses under the discussion course tool all students enrolled were randomly placed into either the control or experimental groups via the grouping tool. Next, each group was given information about the study and directions for week one. All information for each of the two groups was identical except where noted in Figure 1 in step number 4.

Aerosol can topic took place over two weeks and included several parts,

1. The first part was a survey at surveymonkey.com
2. The survey was optional and anonymous, but students were highly encouraged to complete the survey
3. The on-line tool provided was free and in addition to learning a new tool to use, the information gathered was to assist in development of future curriculum for teacher educators
4. Watching the video was required as part of the instructional strategies for the course. There were two versions of the video, but students in the control or experimental group could only view one or the other. The link for the video was assigned on the same page as the directions.
5. Aerosol can topic took place over two weeks and included several parts,
6. The first part was a survey at surveymonkey.com
7. The survey was optional and anonymous, but students were highly encouraged to take it

Figure 1: Study protocol

Directions provided to the students in both the experimental and control groups were as follows:

1. Take a brief survey BEFORE watching the video. When completing the survey, you will need to enter in a number for tracking purposes - As the instructor of the course, I will not be able to access the survey information. Your code is the last 4 digits of your PID followed by 40701 Example for 123440701. (The experimental group was instructed to have a 2 as the last number in the sequence instead of the 1)

Don't worry if you don't know the answers yet- that's why you're in the class! Take Survey Now (live link).

2. ***CONTROL GROUP*** **-** Watch Video. Once you get to the *It's OK to Spray* website, feel free to download and explore the teacher's guide at the top of the page if you choose. There are lots of great activities that can be used with students from elementary to high school. Scroll down, and watch the video (middle of the page). Watch video now (live link)

2. ***EXPERIMENTIAL GROUP*** - Watch video now (live link). Feel free to download and explore the teacher's guide at the top of the page. There are lots of great activities that can be used with students from elementary to high school. Click here for guided notes (live link) if you would like.

3. Think about how you would teach this content in your classroom. Next week we will continue on this topic. Have a great week! Thank you again for completing the survey!

Prior to the end of week one of the study, data collection was not going according to plans and the EEX 4070 class became a pilot for this study. The issues with the study were as follows.

First, the researcher was unfamiliar with the layout of this professor's online course and posted the study information in the discussion section of the course. However, all information regarding assignments and opportunities for this class were traditionally posted in the announcement tools section. Hence, it was not intuitive for students to look in the discussion section and many were unaware of the prospect to participate in the research study.

Second, the students who did locate the information about the study and complete the pretest were unable to view the appropriate intervention. The server used to house the intervention videos online during the time frame of week one of the study was unreliable and the professors of the course received numerous communications from students having attempted to open the video (some several times) with no avail. The researcher, therefore, had no way of knowing if any students were able to watch the intervention assigned, and no way to ensure study protocol was

followed. At this time, the researcher also became aware that even without technological issues fidelity of the treatment would have been difficult to assess since there was no way to know if the group assigned the intervention video in an online course actually accessed the video.

Finally, due to a change in program in the course catalog, all of the students enrolled in SCE 3310 were concurrently enrolled in EEX 4070. As a direct result of the simultaneous enrollment of participants in both classes, a parallel study could not be accomplished. As a result, the researcher had to choose whether or not to continue the study with EEX 4070. Based on the three issues, the decision was made to abandon the remainder of the study with EEX 4070. The completed pretests from EEX 4070 classes were held onto since the participants were also enrolled in SCE 3310, and the researcher did not want the pretest to be filled out a second time prior to treatment. Participants were not given the intervention or posttest as part of this class. However, EEX 4070 was still considered a pilot study to ensure procedures were correctly implemented for the SCE 3310 classes. The following changes were made to address the pilot study issues for SCE 3310:

- The pretest was emailed to everyone in SCE 3310 by the professor to personal email accounts – email was followed up with paper surveys (for those who did not complete it online but wanted to participate) distributed by the researcher in class during week one of the study.
- The researcher showed the appropriate intervention video in person for both the control and experimental group during class time with attendance taken prior to viewing the video to ensure full participation and protect treatment fidelity.

- The researcher went back to each class to distribute and collect the posttest as well as lesson plans from students to ensure high return rates and that data from control and experimental groups were protected.

Population and Setting

The population and setting of this study included PTs from a large state university and the regional campuses associated with said university. Four sections of SCE 3310 (Teaching Science in Elementary Schools) were taught by the same professor at three regional campuses. Only the classes taught by the one identified professor were used in this study. The professor is a Hispanic male with a Ph.D. in a visiting instructor line.

Specifically, each participant was a preservice elementary, general-education teacher enrolled in SCE 3310 which was a face-to-face class. The class locations were determined by student registration for a particular campus. Participation in the study was completely voluntary and only those who completed both the pre and posttest were considered participants. See Table 5 for class enrollment.

Table 5: Course and class enrollment

Section #	Class Name	#Enrolled
1	SCE	26
2	SCE	30
3	SCE	18
4	SCE	35
TOTAL	SCE	109

Population Frame

The PTs enrolled in SCE 3310 were invited to participate since the content area of the module on UDL was science. The course syllabus described this class as "designed to help students learn to teach science to children in ways in which are consistent with what is known about science as well as what is known about the physical, emotional, and cognitive development of children in contemporary society."

Study Participants

The population was dependent upon enrollment in the four sections and voluntary participation. The researcher was provided class lists that had only the last four digits of the schools identification number for each student. During week one of the study, this information was put into SPSS and the randomization feature assigned the PTs to either the control or experimental group. The participants were told to use this four-digit number as their code instead of their name on all study related materials.

A total of 86 of the possible 109 PTs agreed to participate in the study and completed both the pre and post test. Since all 109 PTs were randomly assigned to the control or experimental group prior to the start of the study, the numbers in each group were not equal. Of these 86, 41 were assigned to the control group and 45 to experimental group. All demographics on PTs were taken from self-reported information with three participants not providing demographic information. Descriptive statistics were used to show demographic information about the PTs.

Of the 86 student respondents two did not provide demographic information of the remaining 83; 21 were between 18 and 21 years of age, 40 were between 22 and 28 years old, and 23

participants were over 29 years old. Gender was reported as 74 females and 8 males with 65 of the PTs describing themselves as White Non-Hispanic, 11 Hispanic, 7 African American, and 1 as other. The high percentages in the areas of White and female are consistent with national demographics of elementary school teachers (NEA, 2006). Additional participants were not included as a result of opting out, or failing to complete either the pre or posttest measures. The demographics of these students are not provided. The total number of participants for the pre and posttests is 86.

Research Timeline

The following is a graphic organizer (Figure 2) followed by a brief timeline to assist in understanding of the data collection procedures and to contextualize the various instrumentation tools used within the research.

PRE-INTERVENTION December – February	**Created video intervention**
	Validated video intervention
	Created viewer's guides for control & experimental intervention
PILOT STUDY	
March	Posted link on class website for pretest
	Technology issues with EEX 4070 – study discontinued
FULL STUDY - April	- Randomization of students into control & experimental groups
Week 1	- Pretest link emailed to all students in SCE 3310 by professor
Week 2 – in each class	- Paper pretest given by researcher to students who had not completed the online survey - Participants viewed control or experimental video intervention - Distribution of directions for optional prewriting and mandatory lesson plan assignment
Week 3	- Students completed prewriting and lesson plan on own
Week 4 – in each class	- Students turned in completed lesson plans (scored by researcher using lesson plan scoring rubric) - Posttests given by researcher – (scored by researcher using understanding of UDL rubric)
Week 5	Focus groups – no participants choose to participate
Week 8	Email sent to students asking them to answer three questions about study as a second attempt at social validity data

Figure 2: Timeline of study

In January and February of 2009, the researcher created and validated the intervention video. Then the first week of March preservice elementary education majors in EEX 4070 were asked to participate in a study and the pretest was given to these PTs. Errors occurred with the data collection procedures in this online course causing this course to serve only as a pilot for this study.

The dissertation study commenced during the second week in April when all students enrolled in SCE 3310 were randomly assigned to the control or experimental group. During the first week the students were sent an email from their professor to complete the pretest online (using surveymonkey.com). During week two the researcher visited all four sections of SCE3310 with paper surveys for those students who wanted to participate but had not completed the online survey. After all participants completed the survey, the researcher allowed students in their respective groups to view either the control or experimental video. After both groups viewed the appropriate video, the researcher explained the lesson plan assignment as well as the prewriting option that was to be completed during week three of the study.

In week three the students did not have class but were told to complete the optional prewriting activity and the mandatory lesson plan assignment. The lesson plan was required to be submitted to their professor in class on week four. During week four, the participants submitted hard copies of their plans and completed the posttest survey.

During the fifth week, the researcher held online focus groups with participants and in the eighth week three key focus group questions were emailed to all participants. This e-mail was deemed necessary since students did not show-up to multiple offerings of an online focus group.

Instrumentation

This study used two instruments for intervention, and two instruments for data collection. The interventions included the use of the control and experimental videos and corresponding viewer's guides, as well as an optional prewriting activity for the lesson plan. Two instruments were used to collect data points related to the research questions. The first instrument, a pre and posttest, was used to assess content knowledge and understanding of UDL. The second instrument, the construction of a lesson plan, was used to assess the application of UDL principles. Finally tools used for measures of validity are discussed.

Video Development

The video intervention (VI) for the control group was a science content video professionally created by Consumer Aerosol Products Council (CAPCO) titled *Another Awesome Aerosol Adventure* (see Figure 3). The CAPCO website provides a video description of "a 10-minute video produced by the creative team from the popular children's science television program *Beakman's World.*" The website goes on to state: "Since *Another Awesome Aerosol Adventure* was launched in June of 1995, more than 20,000 orders have been filled, reaching more than two million students" (n.p.). This video was chosen for the study because it met several criteria including, available on the web for free with a lesson plan guide for teachers, content of video was validated by professionals (CAPCO), high video quality including humor, examples, likability and animation, length of movie was approximately 10 minutes, content of video was not commonly known allowing for content learning for PTs and was appropriate for the addition of the three principles of UDL.

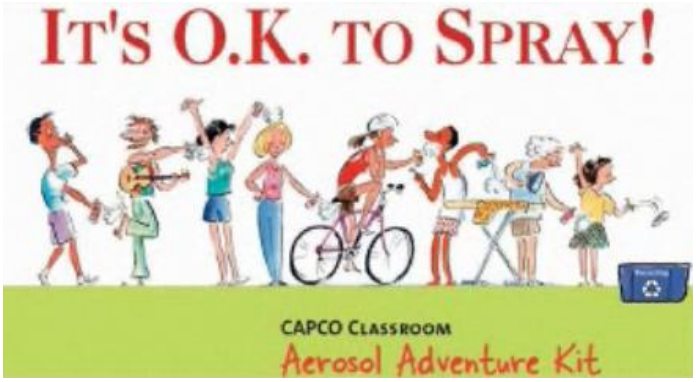

Figure 3: Screenshot - CAPCO video cover

Figure 4 shows the main character in the CAPCO video along with the extra large aerosol can that is used to explain the content of the video. The control group video does not include any information about teaching or UDL and is simply the science video produced by CAPCO with the main character in Figure 5. The information in the VIUDL included the same information about aerosol cans but was enhanced with two additional characters and components of UDL. See Figures 3 and 4 for screen shots from VI and Figures 5 - 17 for screenshots from VIUDL including the incorporation of CAPCO footage and how the UDL principles were integrated with the existing video.

Figure 4: Screenshot - CAPCO's main character

Video Intervention

The video intervention for the experimental group (VIUDL) was also 10-minutes in length and contained CAPCO footage. However, in this video, sections were removed and replaced with video modeling of how to use the CAPCO footage utilizing the principles of UDL. The notion that once in a classroom, PTs will show content videos to their students. By observing ways to use the three principles of UDL in a video, the researcher hoped to increase understanding and possibly application of these concepts. Several steps were completed in order to accomplish the intent of the video, demonstrating the principles of UDL.

First, the process of determining the best way to model a teacher using a UDL lesson plan was explored. In order to model UDL two additional characters were added to the experimental group's video. It was determined that having the video be from a student's point of view would be an intriguing way for PTs to look at the lesson. Hence, Da'Zhaun, a second grade African American male (see Appendix K for video release), narrated the "cool" way his teacher taught the aerosol can content using UDL principles. Since the target audience was elementary school teachers, the researcher wanted to ensure that the student was age appropriate, which led to issues with terminology and pedagogy that this second grader was not at an age to incorporate into his dialogue. To handle this issue, a second virtual narrator was added to not distract from the content of the video nor Da'Zhaun. Ultimately the second narrator was a stick figure avatar that Da'Zhaun refers to for the "technical teaching stuff" throughout the video. See Figure 5 for a screen shot of the two narrators. These narrators enriched the discussion provided by the main character (Figure 4) to be not just about aerosol cans, but also about UDL. The content of the science concepts were kept intact from the CAPCO video and Da'Zhaun and the virtual narrator only enhanced the concepts by talking and showing UDL principles.

Figure 5: Screenshot - Characters added to video intervention UDL

Due to concerns about the PTs prior knowledge about UDL terminology used in the video this issue was presented to the PTs professors. The professors in EEX 4070 and SCE 3310 established that the participants had prior exposure to terminology and examples relating to UDL. Therefore, the purpose of this video was not an initial introduction to the topic but rather a model of "how" UDL looks when implemented in the classroom. From here, the two goals of the video were established, first, to understand the three principles of UDL and second, to demonstrate to PTs how to apply UDL principles in lesson plans (see Figures 6 and 7).

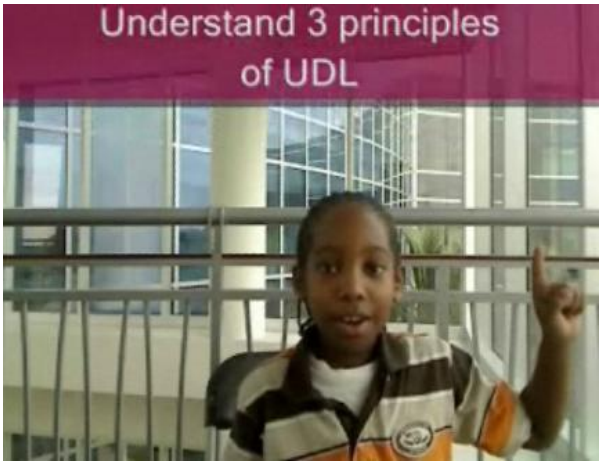

Figure 6: Screenshot - Reviewing three principles of UDL

Figure 7: Screenshot - Focus of experimental group's video intervention UDL

Next, the control group's VI was examined for natural stopping points teachers may use in their classrooms to teach the aerosol can content. To accomplish this task, the researcher created an outline of a lesson plan focusing on materials, procedures, and assessments (see Figure 8). Goals of the lesson plan were not included since the state in which the study took place has state standards and objectives that cannot be altered in lesson plans.

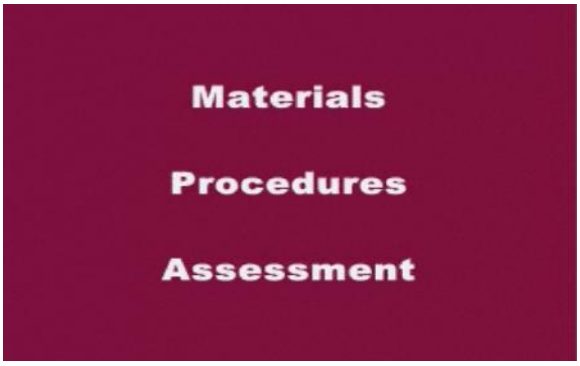

Figure 8: Screenshot - Three parts of lesson plan gone over in video intervention UDL

However, the three learning styles were shown in the VIUDL along with graphic representations (see Figure 9) to demonstrate integration of UDL. Special care was taken to include MMR, MMAE, and MME in each phase of the lesson with specific examples pointed out

to the viewer in the upper left hand corner of the screen when something referred to one of the principles (see Figure 10).

Figure 9: Screenshot - Types of learning styles

Figure 10: Screenshot - CAPCO lady with UDL overlay

The experimental groups' VIUDL was designed using the principles of UDL. The video included graphics in addition to oral explanations, closed captioning, higher order thinking skills, interaction with the viewer, concrete examples, demonstrations, and additional resources. The point being that the VIUDL was to both teach and model UDL principles.

The CAPCO footage in the VIUDL was limited to ensure experimental and control group videos were similar in length. Table 6 shows a timeline of VIUDL including who is on the screen, what is being discussed or demonstrated and the amount of time for each segment. It should be noted that only three minutes and twenty-one seconds of the original CAPCO footage is including

in the VIUDL however the researcher took extreme care to ensure that the content contained the relevant information from the original video. The CAPCO footage was edited down to tenth of second intervals to remove extraneous scenes including those consisting of movement across the screen with no content while limiting repeating of concepts. Additionally, the final minutes of the CAPCO footage was not included for the experimental group since the information presented was targeted for an age group older than elementary school.

Table 6: Timeline of video intervention UDL

Description of video content	Times in video
Introduction by Da'Zaun & Avatar	0:00-1:25
Da'Zaun discussing his teacher's lesson on aerosol cans - Prior knowledge	1:26 - 1:59
Aerosol can movie with UDL overlays	2:00 - 2:42
Da'Zaun talks about activating interest with a scavenger hunt	2:42 - 3:02
Aerosol can movie with UDL overlays	3:02- 3:38
Avatar giving examples of formative assessment in the lesson	3:39 - 4:28
Aerosol can movie with UDL overlays	4:29 – 6:31
Avatar & Da'Zaun discusses higher and lower order thinking questions	6:32 – 7:26
Da'Zaun discusses how his teacher assessed the aerosol can lesson and the experiment he did at home with his mom	7:27 – 8:24
Avatar reviews viewer's higher order thinking question "what does UDL look like in lesson plans?	8:25 – 9:48
Da'Zaun and Avatar review three principles of UDL, the parts of the lesson and thanks viewers for watching	9:49 – 10:12
Credits and contact information	10:13- 10:33

Unique Components of the VIUDL

The unique components of the VIUDL are provided to guide in potential replication of the study. Time codes are provided that reflect the flow from Table 6 to assist the reader with the progression of the video. As noted the two characters, seen in Figure 5, go over the three principles of UDL (see Figure 6) followed by showing examples of how these principles were

integrated into the three parts of the lesson (see Figure 8) with examples of different learning styles (see Figure 9). After the introduction [0:00-1:59}, footage from the original CAPCO movie [2:00-2:42] was integrated with each of the three principles of UDL noted in the upper left corner of the screen when appropriate (see Figure 10). Then Da'Zaun talks about how his teacher activated his interest in the content of the movie through a scavenger hunt [2:42-3:02] and additional CAPCO footage [3:02-3:38]. Next the avatar gives examples of how formative assessment was used in the lesson [3:39-4:28]. Following the aerosol can content of the video [4:29-6:31], Da'Zhaun asks the viewers a concrete question of, "What are the three principles of UDL?" [6:32] Following this question, Da'Zhaun then provides the viewer with the answers. Da'Zhaun then goes on to explain that his teacher gave his class choices about how each student wanted to show their learning of the content and a video clip of him and his mom doing a science experiment is shown [7:27](see Figure 11).

Figure 11: Screenshot - Da'Zhaun doing a science experiment with his mom

Next, the avatar introduces the higher order thinking question of, "What are some ways that UDL can be implemented into lesson planning?" [8:25] (see Figure 12) and Da'Zhaun provides a

review of the entire lesson including concrete examples about materials (see Figure 13) and procedural aspects of lesson planning (see Figure 14). The avatar then reviews the menu of choices that Da'Zhaun had mentioned earlier in the video that were available to the students for assessment of the aerosol can content [9:49] (see Figure 15). Thereby, the video reviewed the aerosol can content, the parts of the lesson plan, and how to use the three principles of UDL within the lesson.

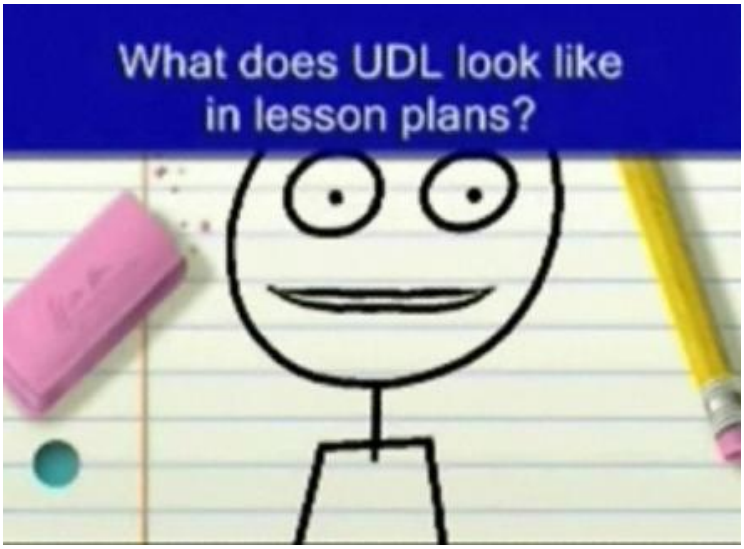

Figure 12: Screenshot - Avatar asking higher order thinking question

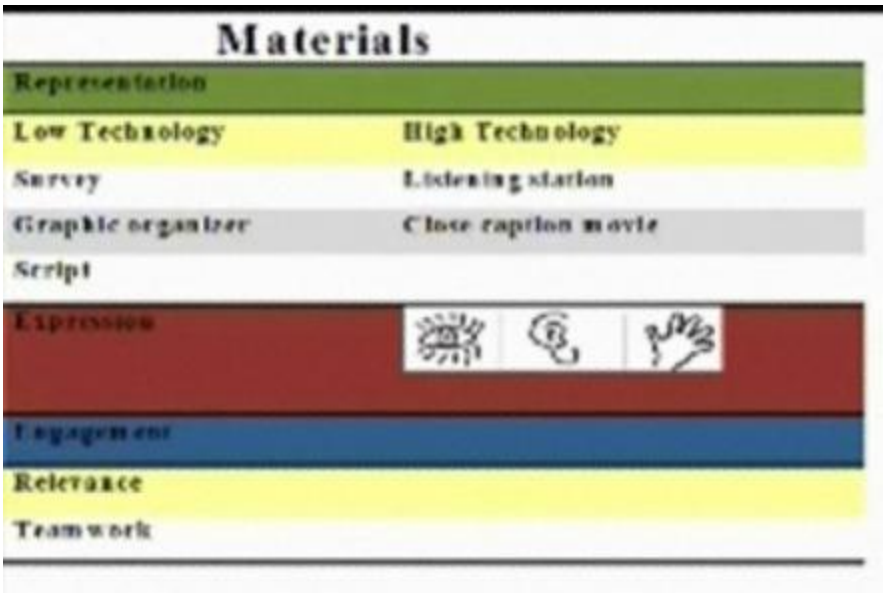

Figure 13: Screenshot - Examples in lesson planning for materials

Figure 14: Screenshot - Procedures part of lesson plan

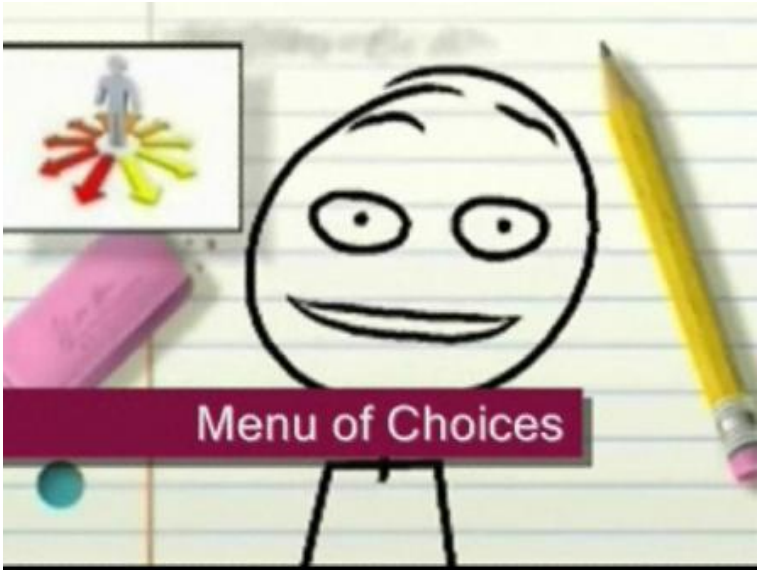

Figure 15: Screenshot - Assessment part of lesson plan

The outline presented for the lesson plan in the video is the same one used by participants to complete the lesson plan activity as described on page 78. The VIUDL ends with Da'Zhaun telling the teachers that they too can be as great as his teacher and provides the website for the entire lesson on aerosol cans from CAPCO [10:07] (see figure 16).

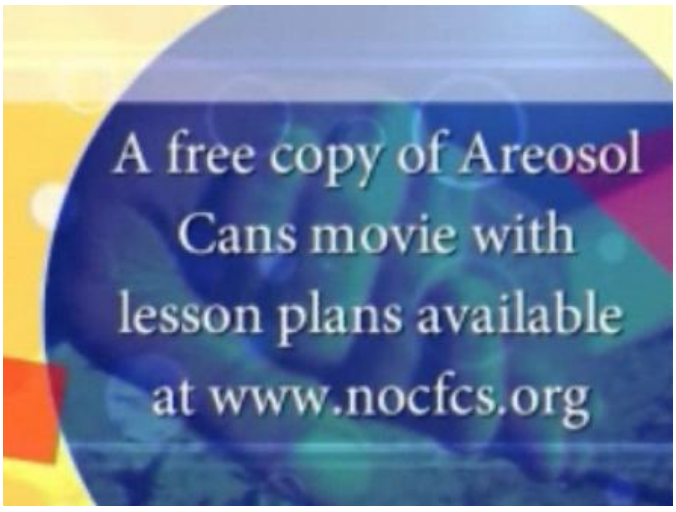

Figure 16: Screenshot - CAPCO contact information for full lesson

Validity of the Video Instrument

The video underwent quality control for content, understandability, and production prior to use in the study. The original video (instrument for control group) had all three areas of quality control as validated from CAPCO. The content of the experimental video received validity from CAPCO upon production completion. The UDL content in the video was validated by four leading researchers in the field of special education as well as by personnel at CAST with no recommendations received by the researcher for editing UDL content. Other minor content or production issues were addressed prior to use with the experimental group.

In order to assure understandability and production quality the experimental video underwent a series of reviews. The first set of reviews conducted after the first round of filming was for the purpose of being able to identify gaps that would need to be addressed during round two. This first round of reviews was conducted by a nationally known professor who often creates her own footage to teach concepts both in her classes and when conducting professional development. The second round of reviews occurred with 18 participants (see Table 7 for demographics) rating the video using surveymonkey.com (see Table 8 for ratings of the video). Based on information collected including open-ended questions about what could be clarified, changed and should not be changed in the video another round of revisions was completed.

Table 7: Video validation participation round 2

I am currently	Percent	Number
A preservice teacher	5.6%	1
A substitute teacher	5.6%	1
Graduate student	44.4%	8
K-12 teacher	44.4%	8
University Faculty Member	5.6%	1
In educational field, but not teaching	11.1%	2
Total	100%	18

Table 8: Ratings for video validation round 2

	Excellent	Above average	Average	Below average	Poor
Quality of UDL content	44.4% (8)	33.3% (6)	22.2% (4)	0%	0%
Movie meets stated goals	52.9% (9)	29.4% (5)	17.6% (3)	0%	0%
Production quality	5.6% (1)	55.6% (10)	27.8% (5)	11.1% (2)	0%
Level of logical sequencing	38.9% (7)	55.6% (10)	5.6% (1)	0%	0%
Appropriateness for intended audience of preservice teachers	33.3% (6)	52.9% (9)	11.1% (2)	5.6% (1)	0%
Quality of aerosol can content	33.3% (6)	44.4% (8)	22.2% (4)	0%	0%
Enjoy ability of movie	44.4% (8)	44.4% (8)	11.1% (2)	0%	0%
Length of movie	44.4% (8)	29.4% (5)	29.4% (5)	0%	0%
Likability of student	72.2% (13)	29.4% (5)	0%	0%	0%
Likability of “crazy lady”	38.9% (7)	44.4% (8)	16.7% (3)	0%	0%
Likability of avatar	27.8% (5)	33.3% (6)	17.6% (3)	0%	5.6% (1)
Overall, how do you rate the movie	52.9% (9)	33.3% (6)	16.7% (3)	0%	0%

A third round of validation was then completed with eight experts in the field giving the final approval for content, understandability, and production quality. Once this third round was

complete, the pilot test began. In addition, the VI and VIUDL were used for the control and experimental groups in each of the four sections of SCE 3310.

Viewer's Guides

To facilitate learning from both the control and experimental intervention videos a two-page viewer's guide was created. The first page of the viewer's guide had an activity that could be completed while watching the video. This page simply had the viewer place a mark next to the idea as it was presented in the video. Since the two videos had different content, the first page of each was slightly different. The second page was the same for both videos. It was CAST's UDL Checklist filled out with lesson ideas specific to using the aerosol can content (Appendix G for control and Appendix H for experimental viewer's guides). Each of the guides listed the three principles of UDL as well as specific principles to look for while watching the video.

Pre and Posttest

The pre and posttests were created by the researcher with the purpose of measuring four different aspects about PTs, 1) knowledge of UDL, 2) understanding of UDL, 3) self-perception of competency in planning to teach students with varying ability levels, and 4) demographic information. See Appendix A for a copy of the instrument. The first page of the pre and posttest consisted of a section related to participants' rights as stated in the IRB. Next, 19 questions (12 multiple choice and a question where the respondent picked the 3 correct answers out of 9 possible choices) were used to measure the knowledge of UDL. Next, four open-ended questions related to understanding UDL were provided. The third section of the pre posttest had 13 questions on a five-point Likert scale with one being the lowest perception of competency and

five being confident in teaching students with varying ability levels in science content. The final four questions, appeared only on the pretest, and asked demographic questions in drop down menus including; age, ethnicity, gender, and desired teaching position. A radio-button which allowed for only a single response per question was used for all questions that were not open-ended. The posttest was exactly the same as the pretest, with the exclusion of the demographic section. Both the pre and posttest were accessed through surveymonkey.com, an online secure data collection website.

In developing the survey, special attention was paid to wording related to materials in an attempt to eliminate biased responses (Dillman, 2000). The 12 multiple-choice questions came directly from the CAST center used with reprint permission. Consequently, the test questions have high content validity as a result of input from the staff at CAST, as well as experts in the field of special education. Prior to administering the test, it was given to a pilot group who provided feedback about possible changes. Those changes were made and retested with a different pilot group meeting requirements for validity of an instrument (Babbie, 1989).

Lesson Plan Application

Validity for the lesson plan and its corresponding scoring rubric were determined after several steps. First, the researcher identified critical content knowledge and skills from the literature and course materials. Next, draft lesson plans were developed with university staff as well as graduate students responding. Changes were made to several drafts in this fashion until "clarity in expectations and consistency in responses were achieved" (Van Laarhoven, Munk, Lynch, Bosma, & Rouse, 2007 p. 445).

Participants were asked to create a lesson plan when given the state standard and a two-minute video of science content. Specifically, the PT was asked to write using the format on the form in Appendix D the materials, methods, and assessments for the varying ability levels of students typically found in an inclusion classroom. Scores for the lesson plans were determined by using a 3-point rubric scale (0 = no response, 1 = undeveloped, 2 = partially developed, 3 = fully developed) (see Appendix E for grading rubric). Each lesson plan was graded twice, once analyzing the materials, methods, and assessment for a possible total score of 12, and again for multiple means of representation, action and expression, and engagement for a possible total score of 9. A composite score was than computed for each lesson plan. By scoring each lesson twice, the researcher hoped to determine if there was a difference in using UDL components in lesson planning compared to simply looking at the components of a traditional lesson plan.

To facilitate learning and model UDL an optional prewriting strategy was made available to participants when the lesson plan was assigned. For the prewriting activity, participants could log into surveymonkey.com and look at the guidelines associated with each principle (done as three separate questions, one for each principle) and brainstorm how those guidelines could be incorporated into the lesson plan they would write for this activity (see Appendix O). The PTs were told to spend no more than two minutes per principle during this quick write activity. The entire prewriting activity was to take approximately six minutes. Of the participants in the study, 54 choose to do the prewriting thereby completing the three questions. Since this was an optional activity for the participants to help guide their lesson planning, no data were taken from this activity other then the number of participants who choose to complete it.

After watching the intervention video, the researcher passed out information and spoke to the students in all four classes about the optional prewriting activity and the mandatory lesson

plan. Students were told that the prewriting was on surveymonkey.com and that the lesson plans would need to be turned in on the day of the final exam as a hard copy.

Research Design

The researcher utilized a quasi-experimental study (Cook & Campbell, 1979) with participants nested within their class and randomly assigned to a control or experimental group. The researcher employed a quantitative analysis to determine the impact of the findings. Data were compared using *t* tests from scores on the pre and posttest as well as from the lesson plan instrument.

Treatment Conditions

Distribution of the pretest was completed in three ways. First, the researcher posted a link to the online pretest on the EEX 4070 class website. Due to error in placement of the link, the responses from participants who also were in SCE 3310 were very limited. Three weeks later (week one of the main study), an email was sent by the professor of SCE 3310 to all four of his classes explaining the opportunity to be involved in a research study. This email included the link to the survey on surveymonkey.com. Students were asked to complete the pretest prior to coming to class only if they had not done so in EEX 4070. In week two, the researcher went into each class with hard copies of the same pretest in paper form to garner a higher response rate.

After all those who choose to participate completed the survey, the researcher went into each of the classes and at the designated time, called out the initials and last four digits of the students' personal identification (PID) in the experimental group. These students were then led to another classroom in the same hall of the building. Simultaneously, both groups (one having the

researcher and the other having the classes professor) were given the option of picking up viewers' guides for the video they were about to watch. Prior to watching the video, the researcher or professor, depending on the classroom, took attendance of who was in the room watching the video. Attendance was taken through the student's initials and PID to verify the participants were in the correct location to watch either the VI or VIUDL video. The respective intervention video was then shown to the group. Following the video, the experimental group was taken back to the original classroom.

Prior to the end of class, but after watching the intervention videos, the researcher explained the lesson plan assignment and provided paper copies of the directions (Appendix D).

For the posttest, the researcher again went to each of the four classes. The final exam was being given during each of the visits. The researcher waited until each student turned in their final exam and then asked each student individually if they would please fill out the posttest. The students who choose to participate filled out the posttest prior to leaving the class for the semester. Participants turned in their lesson plans to the professor who in turn gave the ones from students who had agreed to participate to the researcher.

Watching the video and completion of the lesson plan were class requirements; however the PTs had to volunteer for their lesson plan data to be included in the study. The creating of a lesson plan was turned in for a course grade to the professor with the participant's tracking number and no other identifying information. The professor then allowed the researcher access to the 75 lesson plans for PTs who had given consent.

Voluntary participation in a focus group required an additional informed consent to be signed and returned. There were two focus groups on Adobe Connect, however, no participants attended either focus group. Another effort was tried to receive information about what

participants thought of the study. A second attempt was by email to all of the students enrolled in the four sections of SCE 3310 for spring with three questions. Three of the emails were returned as being invalid and 12 students responded.

Data collection for this study occurred over the course of a spring semester. Both the experimental and control groups were measured on knowledge/understanding and application of UDL as well as self-perception of competency to plan lessons for students of varying ability levels. Table 9 shows the research design of the study including the research questions that were answered and the independent and dependent variables for that question.

Table 9: Research instrumentation

Research Question	Variables	Instrument	Analyses
Is knowledge and comprehension of universal design for learning principles increased when taught in context with elementary content?	IV = UDL in content area video DV = Knowledge/ comprehension of UDL	Pre and posttest	Independent and dependent *t* tests
Does preservice teachers' perception about their ability to serve students with disabilities increase when provided video intervention with universal design for learning?	IV = UDL in content area video DV = self-perception of competency in planning to teach students with disabilities	Pre and Posttest	Independent and dependent *t* tests
Does application of universal design for learning principles increase when taught in context with elementary content?	IV = UDL in content area video DV = application of UDL	Lesson Plan	Independent *t* tests

Fidelity, Validity, and Reliability Measures

Fidelity

All participants had the same conditions and directions for the pre and posttest as well as the lesson plan. The one issue that did emerge was the three different ways students were

administered the survey. This issue caused a need for further analysis of the pretest scores to ensure this breach in fidelity did not influence study findings. Otherwise, fidelity was maintained with the researcher following the same protocol for administering the pre and posttest, watching the intervention videos, and directions for the lesson plan assignment. The researcher showed the appropriate intervention video in person for the experimental group during class time while the professor showed the control group video, with attendance taken prior to showing the videos to ensure the correct students viewed the appropriate intervention video.

Reliability

During data analysis of the pre and posttest, reliability was statistically determined by establishing equality in groups (Dillman, 2000). Inter-rater reliability for the open ended questions on the pre and posttests as well as on the lesson plan were determined with another member of the research team rescoring a random 25% of the pre and posttests open ended questions, the lesson plans, as well as randomly checking 25% of all data entry. Randomization was established by a member of the research team blindly picking from the total stack. Based on Fleiss (1981), inter-rater reliability was established at 80% or greater. Results for inter-rater reliability as well as a description of the research are in chapter four.

Scores for the lesson plans were determined by a rubric using a 3-point scale (0 = no response, 1 = undeveloped, 2 = partially developed, 3 = fully developed) including criteria and examples. Prior to scoring the data from the lesson plans, three members of the research team practiced scoring. Inter-rater agreement was point-by-point for each conducted on 25% of the lesson plans with reliability at 80% or higher.

Validity

To ensure validity of study outcomes of the lesson plan, the researcher randomly picked five lesson plan sheets from the control group and five from the experimental group for a total of ten lesson plans or just over 20%. The researcher placed a coded value on each lesson plan. Three experts in the field were asked to look at these 10 lesson plans and determine which ones were written by someone who was in the control or experimental group and to write the code number of the lesson in the column (see Appendix L) in which it belongs. All three experts looked at all 10 lesson plans and were told that there were five for each column. All three experts were females. One was a visiting assistant professor, and two were doctoral students all in special education. Results are reported in chapter four.

Two focus groups were conducted during week five of the study in an online environment. No participants came to either of the focus groups. The researcher with the assistance of an office manager then sent an email to the students asking them to respond to three questions about the study (see Appendix J for the questions and Appendix N for the email sent). The questions asked were created by the researcher based on the research questions and a review of the literature (Appendix J). The purpose of the focus group was to add information related to what participants thought of the video and how the study impacted their thinking about UDL.

Description of Statistical Analyses

Following data collection, quantitative statistical analyses were completed using SPSS. Descriptive statistics were gathered from the pretest to show demographic information about the PTs.

Analyses for research question one were separated into knowledge and comprehension questions. Prior to data analyses, determinations of differences in groups answering the survey were determined because the pretest was taken by the participants in one of three ways at different points of time. An independent *t* test was conducted to determine whether there was a significant difference in pretest scores, knowledge of UDL and understanding of the principles of UDL, between the participants that were pretested at different times and under different conditions.

Once similarity of groups was determined the composite scores of the 15 knowledge questions (all multiple choice or pick the correct answer questions) were analyzed to answer research question one. Differences in responses were examined using *t* tests. In order to answer the second part of research question one, four open-ended questions on the pre and posttest were utilized to check for an increase in understanding of the major concepts about UDL before and after the intervention. Data analyses were completed for each of the four comprehension questions independently. An independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL after treatment comparing the control and experimental groups for each of the four questions on the posttest. Finally, two dependent *t* tests were performed to determine if there was a statistically significant difference in each the control and experimental groups when compared to themselves on the pre and posttest.

Prior to answering research question two, a composite score calculated from the 12 questions relating to perceived confidence interval was compiled for each participant on the pre and posttest respectively. Next, independent *t* tests were conducted to determine whether there was a significant difference in pretest scores (confidence interval about teaching) between three groups that were pretested under different conditions. Then, an independent *t* test was conducted to

evaluate if there was a statistically significant difference between the control and experimental groups posttest scores. Finally, paired sample *t* tests were completed to determine if a statistically significant difference existed between the control groups' pre and posttest scores and/or the experimental groups' pre and posttest scores.

Question three was answered by using the scores from the lesson plan assignment. Each lesson plan was scored twice. The first scoring could result in a score from 0 to 12. The second scoring could result in a score of 0 to 9. Finally a composite score was compiled. With these three groups of scores from the lesson plan analyses, independent *t* tests were completed comparing control and experimental groups' performance.

CHAPTER FOUR: RESULTS

Overview of Data Analysis

The purpose of this study was to investigate PTs knowledge, understanding and application of universal design for learning. To answer this question the researcher looked at PTs confidence level ratings related to teaching a wide range of learners in the general education setting. In effect the data collected were used to answer the following research questions:

1. Does knowledge and comprehension of universal design for learning principles increase when taught in context with elementary content?
2. Does preservice teachers' perception about their ability to serve students with disabilities change when provided video intervention with universal design for learning?
3. Does application of universal design for learning principles increase when taught in context with elementary content?

The chapter begins with a pre-research analysis to ensure the homogeneity of pretest scores. Next, overall analyses of the data by research question are provided to determine whether statistically significant differences occurred between the control and experimental groups. The chapter concludes with a discussion of fidelity, reliability and validity of the findings.

Pre-research Analyses

To prevent PTs who had completed the pretest assessment online during the pilot study from retaking the survey, the decision was made to include these 11 pretests. In addition, some PTs completed the pretest using an online tool and others completed a paper and pencil assessment.

Prior to answering the research questions, a critical variable, of how participants took the pretests, was addressed to ensure homogeneity of the three groups' pretest scores. These beginning analyses were critical due to the fact that the participants took the pretest at three different times in two ways. An initial comparative analysis across the three variables was conducted to ensure homogeneity in the control and experimental groups at the pretest level. Although the researcher hoped to have all students complete the survey online, it was not until after the pilot study was abandoned that the researcher realized that students in EEX 4070 (the pilot group) were all the same students in SCE 3310. Therefore, further data analyses were conducted on the scores for the three groups: (a) one group took the survey prior to April 5, n = 11 (to be known as the early group), (b) another group took the survey after April 12 online, n = 39 (to be known as the online group), and (c) the third group took the survey after April 12 in a paper and pencil format, n = 36 (to be known as the paper group).

To ensure these pretest differences did not influence the groups at the initial phase of the study, independent *t* tests were conducted to determine whether a significant difference existed in pretest scores, knowledge of UDL and confidence interval about teaching. In order to determine if differences existed four different analyses were necessary; a) early and online, b) early and paper, c) online and paper, and d) control and experimental. All analyses were conducted using a 95% confidence interval (see Table 10).

Table 10: Differences in pretest conditions for knowledge

	Knowledge of UDL	Confidence Interval about teaching
Early & online	*t*(48) = .24, p = .81 early (M = 10.0, SD = 4.0) online (M = 9.74, SD = 2.82) not significantly different	*t*(48) = -1.40, p = .17 a (M = 35.55, SD = 16.182) b (M = 42.44, SD = 13.922) not significantly different
Early & paper	*t*(45) = 1.53, p = .13, early (M = 10.0, SD = 4.0) paper (M = 8.39, SD = 2.73) not significantly different	*t*(12.31) = -.38, p = .71 a (M = 35.55, SD = 16.182) c (M = 37.47, SD = 9.779) not significantly different
Online & paper	*t*(73) = 2.11, p = .04, online (M = 9.74, SD = 2.82) paper (M = 8.39, SD = 2.73) statistically significant difference	*t*(73) = 1.77, p = .08 b (M = 42.44, SD = 13.922) c (M = 37.47, SD = 9.779) not significantly different
Control & Experimental	*t*(84) = .97, *p* > .05 control (*M* = 9.54, *SD* =2.68) experimental (*M* = 8.91, *SD* = 3.26) not significantly different	*t*(84) = .58, *p* > .05 control (*M* = 40.32, *SD* =11.99) experimental (*M* = 38.71, *SD* = 13.63) not significantly different

The early group had no statistically significant difference with either the online or the paper groups for either section of the pretest. However, the online and paper groups did show a statistically significant difference (p = .04) in the knowledge section of the pretest. This difference should be somewhat accounted for in the randomization of participants between the control and experimental groups (see Table 11). All compared groups contained close to equal numbers from each group, attempting to minimize this significant difference. As shown by an independent *t* test, no significant difference existed between experimental (M = 8.91, SD = 3.26) and control group (M = 9.54, SD =2.68). The test was not significant, $t(84) = .97$, $p > .05$. The 95% confidence interval for the difference in means ranged from -.66 to 1.91. However, the potential for error in each of these analyses is possible. Therefore, the researcher had some level of confidence that homogeneity of the groups existed despite the fact that the pretest was administered at various times. Due to a confidence interval of 95% that only one potential difference existed (between the paper pencil vs. online) and this variable was minimized due to randomization of participants.

Table 11: Distribution of participants between groups

Group	Control	Experimental	Total
Early	5 = 6%	6 = 7%	11 = 13%
Online	16 = 19%	23 = 27%	39 = 45%
Paper	20 = 23%	16 = 19%	36 = 42%

Additional pre-research analyses were conducted with the self-perceived confidence interval section of the pretest assuming parity amongst the groups to allow for comparison of pre-posttest scores. A composite score calculated from the 12 questions relating to perceived confidence

interval was compiled for each participant on the pre and posttest respectively. Each participant was asked to; *please rate your confidence level for performing the following teaching tasks in elementary science with students of varying ability levels.* Figure 17 shows the questions and possible answers. The composite score was compiled using a five-point Likert Scale for the possible answers reflecting the PTs perceptions were scored as follows; 1) completely unprepared, 2) somewhat unprepared, 3) adequately prepared, 4) somewhat prepared, and 5) completely prepared. Therefore, the lowest possible composite score was 12 and the highest possible score was 60. The composite scores were then entered into SPSS for data analyses. The second column shows level of statistical significance between the three groups that took the pretest and the control and experimental groups when it came to the confidence interval questions. These findings show no significant difference between any of the three groups that took the pretest at different times or in different formats. Hence, the homogeneity of the group prior to intervention at a 95% confidence level was established.

	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for perception	○	○	○	○	○
Provide options for language and symbols	○	○	○	○	○
Provide options for comprehension	○	○	○	○	○
Provide options for physical action	○	○	○	○	○
Provide options for expressive skills and fluency	○	○	○	○	○
Provide options for executive functions	○	○	○	○	○
Provide options for recruiting interest	○	○	○	○	○
Provide options for sustaining effort and persistence	○	○	○	○	○
Provide options for self regulation	○	○	○	○	○
Provide multiple means of representation	○	○	○	○	○
Provide multiple means for action and expression	○	○	○	○	○

Figure 17: Confidence level questions

Understanding Universal Design for Learning Data

The section of the pre posttest that looks at PTs level of understanding of UDL consists of four open ended questions. When each of these questions is described in the analyses, they are referred to using an abbreviation. The four questions and their subsequent abbreviations used when describing the analysis are provided in Table 12.

Table 12: Open-ended questions for understanding of UDL

Question	Abbreviation
1. Please summarize your understanding of universal design for learning.	UDL
2. Describe your understanding of multiple means of representation and how it relates to designing curriculum.	MMR
3. Describe your understanding of multiple means of action and expression as well as how it relates to designing curriculum.	MMA&E
4. Describe your understanding of multiple means of engagement and how it relates to designing curriculum.	MME

Related to this research question, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL prior to treatment in the control and experimental groups for each of the four questions. Table 13 shows that all four questions did not have a statistically significant difference between the control and experimental groups on the pretest.

Table 13: Understanding of UDL prior to intervention

Question	Pretest scores compared	Significance
UDL	$t(84) = -1.01$, $p > .05$	Not significant
	control group ($M = .98$, $SD = 1.08$)	
	experimental group ($M = 1.22$, $SD = 1.17$)	
MMR	$t(84) = -.25$, $p > .05$	Not significant
	control group ($M = 1.29$, $SD = 1.21$)	
	experimental group ($M = 1.36$, $SD = 1.15$)	
MMA&E	$t(84) = -1.10$, $p > .05$	Not significant
	control group ($M = .66$, $SD = .99$)	
	experimental group ($M = .91$, $SD = 1.13$)	
MME	$t(84) = .59$, $p > .05$	Not significant
	control group ($M = 1.27$, $SD = 1.10$)	
	experimental group ($M = 1.13$, $SD = 1.04$)	

Note. UDL – universal design for learning; MMR – multiple means of representation; MMA&E – multiple means of action and expression; MME – multiple means of engagement

Question One

Does knowledge and comprehension of universal design for learning principles increase when taught in context with elementary content?

Knowledge about Universal Design for Learning

A composite score calculated from the 15 knowledge questions (all multiple choice or choose the correct answer questions) were examined using *t* tests. The following tests were calculated

using SPSS with the control group, $n = 41$ and the experimental group $n = 45$. With the caveat that some potential differences existed between pre-post-test group, but most should be accounted for by the randomization of participants, as there were no statistically significant differences between the control and experimental groups.

First, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs knowledge of UDL principles when taught in context with elementary content. The test was not significant, $t(84) = -.20$, $p > .05$. Participants in the control group ($M = 10.88$, $SD = 2.32$) and experimental group ($M = 10.98$, $SD = 2.36$) showed no significant difference when the two groups' posttest scores were compared. The 95% confidence interval for the difference in means ranged from -1.10 to .90.

Further examination of the data using paired sample *t* tests was completed to determine if a statistically significant difference existed between the control groups' pre and posttest scores and/or the experimental groups' pre and posttest scores. The control groups' test scores indicated that posttest scores ($M = 10.88$, $SD = 2.32$) were significantly greater than pretest scores ($M = 9.54$, $SD = 2.68$, $t(40) = -3.20$, $p < .05$. The 95% confidence interval for the mean difference between the two scores ranged from -2.19 to -.49. Similarly, the experimental groups' test scores indicated that posttest scores ($M = 10.98$, $SD = 2.36$) were significantly greater than pretest scores ($M = 8.91$, $SD = 3.26$, $t(44) = -4.28$, $p < .05$). The 95% confidence interval for the mean difference between the two scores ranged from -3.04 to -1.09. Therefore, even though there were no statistically significant differences between the control and experimental groups' posttest scores, both groups did gain a statistically significant difference in the composite score of knowledge of UDL between the pre and posttest. This may be accounted for by the participants having a module on UDL in their EEX 4070 class during the time of the study. A summary of

the results about the knowledge of UDL questions from the pre and posttest are provided in Figure 18.

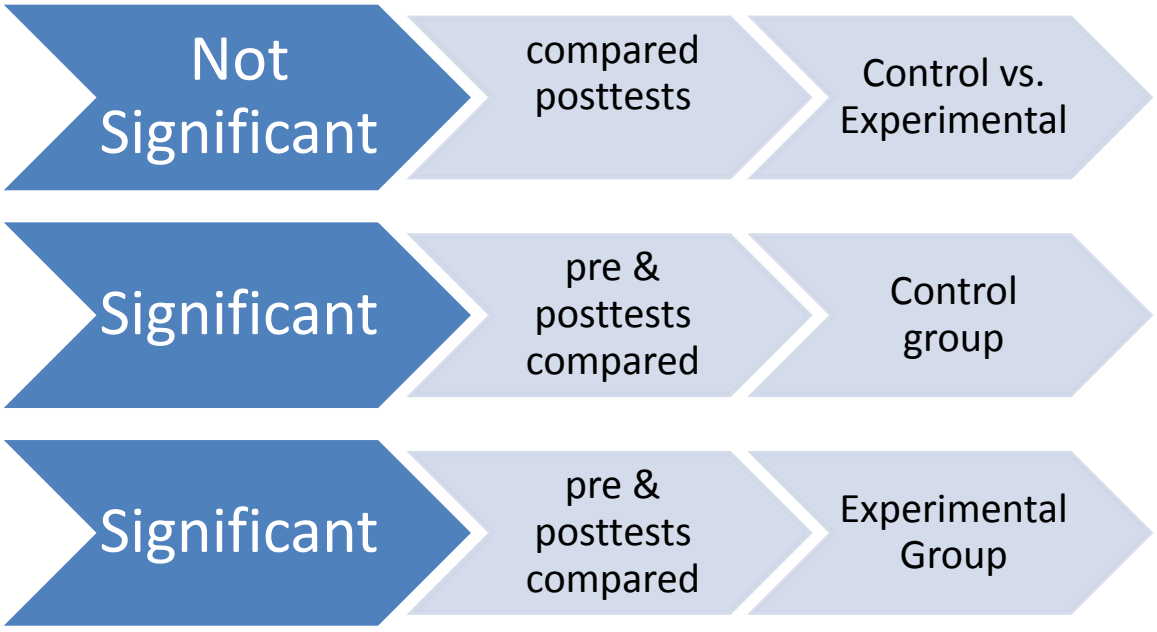

Figure 18: Summary of knowledge of UDL questions from survey

Scoring of Comprehension Questions from Pre and Posttest

Four open-ended questions on the pre and posttest were utilized to check for an increase in understanding of the major concepts about UDL before and after the intervention. Participants' answers were rated according to the scoring rubric in appendix M. When the answer was left blank or if the participant wrote *I don't know*, the score given was a zero. If the question was answered but the researcher could not determine the participants' meaning from the stated answer, the question was given a one. A two was given for partially developed answers that the researcher could determine that the participant had the correct idea, but it was not fully expressed. Fully developed answers that demonstrated a firm understanding of the concept were given a score of three. For example, on question one a participant who wrote "I don't know"

received a score of zero but another who wrote “meeting every learner” the score of one was given as this answer had limited information. An example of an answer that was given a score of two was “It is a process of teaching lessons accommodating every type of student. Making lessons that accommodate students with disabilities.” The reason behind the score of two is that the participant’s answer demonstrates in the response that UDL is something for students with disabilities as opposed to a teaching strategy that incorporates all students. The answer “I think it is a program where there is a 'universal' way of providing flexible learning environments and programs for all students including but not limited to students with disabilities” received a score of three since it included both flexible learning and that all students should benefit.

Table 14 shows the frequencies in numbers and percents of each type of answer given by participants on both the pre and posttest. These scores are further broken down by the control and experimental groups.

Table 14: Frequency table of UDL understanding

	Control Group n = 41				Experimental Group n = 45			
	blank or IDK	cannot determine meaning	partially developed	firm under-standing of concept	blank or IDK	cannot determine meaning	partially developed	firm under-standing of concept
UDL pre	19 (46.3%)	9 (22%)	8 (19.5%)	5 (12.2%)	18 (40%)	7 (15.6%)	12 (26.7%)	8 (17.8%)
UDL post	12 (29.3%)	5 (12.2%)	9 (22%)	15 (36.6%)	4 (8.9%)	6 (13.3%)	15 (33.3%)	20 (44.4%)
MMR pre	17 (41.5%)	3 (7.3%)	13 (31.7%)	8 (19.5%)	15 (33.3%)	8 (17.8%)	13 (28.9%)	9 (20%)
MMR post	12 (29.3%)	7 (17.1%)	13 (31.7%)	9 (22%)	7 (15.6%)	10 (22.2%)	12 (26.7%)	16 (35.6%)
MMAE pre	26 (63.4%)	6 (14.6%)	6 (14.6%)	3 (7.3%)	24 (53.3%)	7 (15.6%)	8 (17.8%)	6 (13.3%)
MMAE post	20 (48.8%)	11 (26.8%)	6 (14.6%)	4 (9.8%)	10 (22.2%)	12 (26.7%)	10 (22.2%)	13 (28.9%)
MME pre	15 (36.6%)	5 (12.2%)	16 (39%)	5 (12.2%)	17 (37.8%)	9 (20%)	15 (33.3%)	4 (8.9%)
MME post	11 (26.8%)	12 (29.3%)	10 (24.4%)	8 (19.5%)	4 (8.9%)	14 (31.1%)	19 (42.2%)	8 (17.8%)

IDK = I don’t know

It should be noted in Table 14 that the number of questions receiving a score of zero decreased in all questions for both the control and experimental groups between the pre and posttests. However, in order to further examine the data beyond simple frequencies, inferential statistics were compiled.

Comprehension Question Analyses

Data analyses for the comprehension questions on the pre and posttest were completed individually for each of the four questions on this section of the instrument. First, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL after treatment comparing the control and experimental groups for each of the four questions on the posttest. Finally, two dependent *t* tests were performed to determine if a statistically significant difference exists in each the control and experimental groups when compared to themselves on the pre and posttest.

Next, an independent *t* test was conducted to evaluate the hypothesis that no statistically significant difference exists in PTs understanding of UDL after treatment between the control and experimental groups. Levene's Test (1960) for equality of variances assesses the normality of the data by requiring a significance level of .05 or greater. When a significance level on a Levene's Test has a significance level of less than .05, there is a need for a more strict alpha value when evaluating between-subject effects. In this study, Levene's Test indicated significance for questions one and four, therefore equal variances were not assumed for those questions in order to reduce the likelihood of a Type I error. Equal variances were assumed for questions two and three. Table 15 shows that only question three, MMA&E, showed a significant difference between the control and experimental groups' posttest scores.

Table 15: Significance in posttest scores for understanding UDL

Question	Pretest scores compared	Significance
UDL	$t(84) = -1.97$, $p > .05$	Not significant
	control group ($M = 1.66$, $SD = 1.26$)	
	experimental group ($M = 2.13$, $SD = .97$)	
MMR	$t(84) = -1.49$, $p > .05$	Not significant
	control group ($M = 1.46$, $SD = 1.14$)	
	experimental group ($M = 1.82$, $SD = 1.09$)	
MMA&E	$t(84) = -1.10$, $p < .05$	Significant
	control group ($M = .85$, $SD = 1.01$)	
	experimental group ($M = 1.58$, $SD = 1.14$)	
MME	$t(84) = -1.51$, $p > .05$	Not significant
	control group ($M = 1.37$, $SD = 1.09$)	
	experimental group ($M = 1.69$, $SD = .87$)	

Subsequently, two paired sample t tests were conducted comparing the pre and posttest scores of the control and experimental group to themselves after treatment for each of the four questions concerning understanding of UDL. The results for the control groups pre and posttest scores showed a statistically significant difference for only one question, however in this instance it was question one, understanding of UDL (see Table 16). Questions two, three, and four were not significant ($p > .05$). Overall, the control group did not make statistically

significant gains on their understanding of the three principles of UDL (questions two, three, and four).

Table 16: Control groups pre and posttest scores for understanding of UDL- Paired Samples Test

	Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
Pair 1	UDLpre - UDLpost	-.683	1.083	.169	-1.025	-.341	-4.039	40	.000
Pair 2	MMRpre - MMRpost	-.171	1.447	.226	-.628	.286	-.755	40	.455
Pair 3	MMAEpre - MMAEpost	-.195	1.100	.172	-.542	.152	-1.135	40	.263
Pair 4	MMEpre - MMEpost	-.098	1.338	.209	-.520	.325	-.467	40	.643

The results for the experimental groups' pre and posttest scores showed a statistically significant difference for all four questions concerning understanding of UDL (see Table 17).

Table 17: Experimental groups pre and posttest scores for understanding of UDL- paired samples test

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	df	Sig. (2-tailed)
Pair 1	UDLpre - UDLpost	-.911	1.145	.171	-1.255	-.567	-5.340	44	.000
Pair 2	MMRpre - MMRpost	-.467	1.392	.207	-.885	-.049	-2.250	44	.030
Pair 3	MMAEpre - MMAEpost	-.667	1.398	.208	-1.087	-.247	-3.199	44	.003
Pair 4	MMEpre - MMEpost	-.556	1.179	.176	-.910	-.201	-3.162	44	.003

The first research question in this study asked if knowledge and comprehension of UDL principles increased when taught in context with content. This change was measured using the pre and posttest sections relating to knowledge and comprehension.

When the composite scores calculated from the 15 knowledge questions (all multiple choice or choose the correct answer questions) of the control and experimental groups' posttest scores were examined using an independent *t* test no statistical significance was found. Upon further examination of the data, statistical significance was found when both the control and experimental groups' pre and posttest scores were compared within the respective group to pretest scores.

Each of the four questions on the pre and posttest relating to understanding the concepts of UDL were run as separate *t* tests. In the case of each of the four questions, no statistically significant difference existed between groups prior to intervention. When the data were run comparing posttest scores for each of the four questions relating to the control and experimental groups, only question three (MMAE) showed statistical significance. Finally, the data were run comparing control and experimental groups to themselves after the intervention. For the control group, only question one (relating to what is UDL) had a significant difference. In the case of the experimental group, all four questions had a statistically significant difference between the pre and posttest scores.

Question Two

Does preservice teachers' self-perception of ability to serve students with disabilities change?

To answer this question, an independent *t* test was conducted to evaluate the null hypothesis. The test was not significant, $t(84) = -.35$, $p > .805$. Participants in the control group ($M = 43.71$, $SD = 10.96$) and experimental group ($M = 44.49$, $SD = 9.77$) showed no significant difference when the two groups' posttest scores were compared. The 95% confidence interval for the difference in means ranged from -5.23 to 3.66.

Further examination of the data using paired sample *t* tests were completed to determine if a statistically significant difference existed between the control groups' pre and posttest scores and/or the experimental groups' pre and posttest scores. The control groups' test scores indicated that posttest scores ($M = 43.71$, $SD = 10.96$) were not significantly greater than pretest scores ($M = 40.32$, $SD = 11.99$, $t(40) = -1.42$, $p > .05$. The 95% confidence interval for the mean difference between the two scores ranged from -8.23 to 1.44. The standard effect size index was .021. On

the contrary, the experimental groups' test scores indicated that posttest scores (M = 44.49, SD = 9.77) were significantly greater than pretest scores (M = 38.71, SD = 13.63, $t(44) = -2.68$, p = .01. The 95% confidence interval for the mean difference between the two scores ranged from –10.13 to -1.42. Therefore, even though there were no statistically significant differences between the control and experimental groups' posttest scores for this section of the instrument, the experimental groups illustrated a statistically significant difference between pre and posttest composite scores for self-confidence. One may speculate, that by modeling the principles of UDL, the PTs understood and felt better prepared to implement approaches therefore, increasing self-perception of being able to teach students of varying ability levels.

Question Three

Does application of universal design for learning principles increase when taught in context with elementary content?

Scoring of the Lesson Plan

The lesson plans were graded according to the rubric in Appendix E which was designed to have a total of three scores for each lesson plan. The first score from part I was compiled from rating the sections on listing of materials, accessing prior knowledge, teaching of new concepts, providing practice, and assessment. For each of those five categories, a score was given from zero to three with a minimum possible composite score of zero and a maximum possible composite score of fifteen. See Table 18 for part I scoring guide.

Table 18: Lesson plan part I scoring guide

If blank – 0	1	2	3
Materials	Standard Classroom Books, texts, paper, pens, markers, scissors, glue, rulers, tape, stapler	Technology Anything with a battery, electrical cord, or solar panel	Visual / Auditory/ Tactile Has materials for all 3 types of learners
Procedures *Prior Knowledge*	Includes at least 1 activity with background information	At least 2 activities with background information	3 or more activities with background information
Teaching of New Concepts	No specific content and No RBP	Specific content mentioned OR RBP	Specific content mentioned using RBP
Practice/Formative Assessment	Includes at least 1 activity for practice/ guided learning/ or formative assessment	At least 2 activities with practice/ guided learning/ or formative assessment	3 or more activities with practice/ guided learning/ or formative assessment
Assessment	Independent written assignment OR Test	Working in groups of 2 or more OR Class assigned an independent non written assignment	Menu of Choices

Note. RBP = Research based practice

Part II of the scoring guide measured the use of the three principles of UDL in the participants' lesson plans. The scoring for part II used the rubric in Table 19 along with the UDL checklist designed by CAST (Appendix E). For example, MMR incorporates 12 criteria (Table 20) defined by CAST. However it is highly unlikely that any PTs would include all 12 in any lesson. Therefore, the researcher decided that if a PT utilized three of the 12 criteria under MMR the maximum possible points, three, for that section would be allocated. This process was repeated for each of three principles of UDL for a minimum composite score of zero and a maximum composite score of nine.

A final composite score was calculated for part III by adding the scores from parts I and II. This composite score ranged from zero to 24. It should be noted that since the data were qualitative and the researcher converted it to quantitative data for analyses that the scoring range between zero to one, one to two, and two to three are not necessarily equal in value as to effectiveness of the counted criteria. For example, showing a video would have received the points for MMR however showing a movie with close captioning would have received the same score even though it is adding another layer, it is adding a layer to a guideline that the point value was already awarded.

Table 19: Lesson plan part II scoring guide

0 for no examples	1	2	3
Representation (MMR)	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines
Expression (MMA&E)	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines
Engagement (MME)	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines

Table 20: Multiple means of representation: Guidelines and criteria

Provide options for perception	
	Customize the display of information
	Provide alternatives for auditory information
	Provide alternatives for visual information
Provide options for language and symbols	
	Define vocabulary and symbols
	Clarify syntax and structure
	Decode text and mathematical notation
	Promote cross-linguistic understanding
	Illustrate key concepts non-linguistically
Provide options for comprehension	
	Provide or activate background knowledge
	Highlight critical features, big ideas, and relationships
	Guide information processing
	Support memory and transfer

Lesson Plan Data Analyses

In order to determine whether a significant difference exists in lesson plan scores between the control and experimental groups, three *t* tests were conducted. Each of the three was completed between the control and experimental groups (see Table 21). All analyses were conducted using a 95% confidence interval.

Table 21: Group statistics for lesson plan scores

	Control or Experimental	N	Mean	Std. Deviation	Std. Error Mean
Part I	control	39	8.62	3.075	.492
	experimental	36	9.67	2.976	.496
Part II	control	39	4.97	2.121	.340
	experimental	36	5.92	2.407	.401
Part III	control	39	13.56	4.806	.770
	experimental	36	15.58	5.140	.857

The first independent *t* test was conducted with the data from part I to evaluate if a significant difference was found between the control ($n = 39$) and experimental ($n = 36$) groups' mean scores. The test was not significant, $t(73) = -1.50$, $p > .05$. The second independent *t* test was conducted with the data from part II to appraise if a significant difference occurred between the control and experimental groups scores on using UDL in the lesson plans. Again, the test was not significant, $t(73) = -1.80$, $p > .05$. The final independent *t* test was conducted using the data from part III, the composite score of both parts I and II. Once more, the test was not significant, $t(73) = -1.76$, $p > .05$. No statistically significant difference was found on the participants' lesson plan scores between control or experimental grouping related to question three.

Several participants did not use the content from the video on "Reasons for the Seasons" as instructed (see Appendix D). The researcher is unsure why specific instructions were ignored and struggled with whether or not to include the lesson plans that were off topic in data analyses.

After data collection was complete, it was mentioned in casual conversation that some participants had trouble accessing the Brainpop video due to technology, however since this happened after the conclusion of the study, no further action could be taken to resolve the issue. A second limitation with the lesson plan had to do with copying of lesson plans from the internet. The same lesson plan was turned in by several participants, some with reference to the website from which it came, others without a reference. In some cases the lesson plan was changed to add UDL and in other cases it was not. From this fact it was difficult to determine if the addition of UDL components had to do with the intervention or another factor, such as activities occurring in other courses such as EEX 4070.

Reliability of Data Collection

Following completion of the study, a random sample of 20 of the 86 pretests and 20 of the 86 posttests were selected to compute point-by-point inter-rater reliability at 80% or higher (Fleiss, 1981) for each of the four open ended questions about understanding of UDL. This inter-rater reliability was conducted between the researcher and a non-biased colleague. Reliability scores were calculated specific to each individual question both pre and posttest to ensure that the standard of reliability did not vary. The inter-rater reliability met the criteria for all eight questions, the four questions on the pretest and the four questions on the posttest with point-by-point reliability ranged from 95% with four questions to as high as 100% with four questions (see Table 22).

Table 22: Inter-rater reliability for understanding of UDL

	Inter-rater reliability
UDL pre	95%
MMR pre	100%
MMA&E pre	100%
MME pre	95%
UDL post	100%
MMR post	95%
MMA&E post	100%
MME post	95%

Following the completion of the study, a random sample of 20 of the 75 lesson plans (27%) were selected to compute point-by-point inter-rater reliability for each item scored on the rubric for parts I and II. Reliability scores were calculated across each individual item to ensure the standard of reliability did not vary markedly among sections of the rubric. The inter-rater reliability met the criteria for all eight items (Slavin, 2007). Point-by-point reliability ranged from 85% in one area to as high as 100% on three areas (see Table 23).

Table 23: Inter-rater reliability for scoring of lesson plans

	Inter-rater reliability
Materials	95%
Prior knowledge	95%
Teaching New concepts	90%
Practice	95%
Assessment	85%
MMR	100%
MMA&E	100%
MME	100%

Validity

Expert Validity

Five lesson plans were randomly selected from both the control and experimental groups each having the identifying information removed and replaced with a coded value. Three experts in the field were asked to look at the lesson plans and determine if each lesson plan belonged to someone who was in the control or experimental group by writing the number of the lesson in the column in which it belongs. All three experts looked at all 10 lesson plans and were told that there were five for each column. Two of the experts followed these directions exactly whereas one expert (rater number 2) put seven lesson plans in the control category and three in the experimental category. Table 24 shows the ratings for each of the lesson plans.

Table 24: Lesson plans scores from validity table

Lesson plan number	Rater 1	Rater 2	Rater 3	Total correct
Control 1	Correct	Incorrect	Incorrect	1
Control 2	Incorrect	Correct	Incorrect	1
Control 3	Incorrect	Correct	Correct	2
Control 4	Correct	Correct	Correct	3
Control 5	Correct	Correct	Correct	3
Experimental 1	Correct	Incorrect	Incorrect	1
Experimental 2	Incorrect	Incorrect	Correct	1
Experimental 3	Correct	Correct	Correct	3
Experimental 4	Correct	Correct	Correct	3
Experimental 5	Incorrect	Incorrect	Incorrect	0
Total correct	6	6	6	18/30

This lack of accuracy in viewing differences between participants in the control and experimental groups further emphasizes the quantitative data relating to research question three. Statistically significant differences were not found on the participants' lesson plan scores as determined by control or experimental grouping nor were experts in the field able to distinguish differences adding to the validity of analyses.

Social Validity

Since no information could be gathered from the focus groups due to lack of attendance by participants, an email with the following three questions was sent to all students in the study. The hope was that some level of participant feedback on the process could be gathered from the questions. The three questions selected were as follows.

1. There were two version of the aerosol can video. Did you watch the one with a young boy and an avatar narrating (this version also talked about UDL), or the version that talked about aerosol cans?
2. Do you feel the video you watched helped you learn more about UDL? Feel free to explain.
3. Overall, what did you think of the video you watched?

Of the 86 possible participants three emails were returned as a result of inactive email addresses and 15 or 18% answered the email. Of the 15 participants for this part of the study, six self identified as watching the video that was only about aerosol cans and thereby in the control group.

These questions were designed to solicit information from the experimental group. Subsequently, only the nine participants that self identified as watching the video with the young boy and avatar are reported. All nine reported that the video helped them learn more about UDL. For the third question, of the nine participants from the experimental group six used the word "informative" and eight used the terminology such as "Interesting, not boring, fun, entertaining, and/or enjoyed." All feedback was positive in regards to the VIUDL. "Instead of just reading lectures on what UDL is, I felt the video actually showed examples which furthered my

understanding" was a quote from one participant for question two. This response encompasses the overall themes presented by all nine experimental group members. One of the participants stated for question three, "I really enjoyed the film, it has been awhile since I saw it, but I remember it helping me to better grasp what the concept of UDL was. In the course that we were taking at the time, UDL seemed like this really large undertaking, the video helped to illustrate the ways in which to break it (any subject really) down so the topics don't have to be so overwhelming."

Fidelity

Fidelity of the implementation of the procedures in this study required the researcher to use the same terminology, time frame, directions, instruments, and statements from student questions. The one issue of the different ways students were administered the pretest was dealt with by further analyses to ensure this breech in fidelity did not influence study findings. Fidelity was accomplished by strictly following the studies protocol for procedures. After each class, the researcher met with the professor to ensure protocol was followed. Additionally, the researcher ensured that the length of the interventions and science content was the same for both videos. The one point where fidelity was an issue, how and when pretests were completed, was addressed through an analyses conducted to reestablish fidelity of grouping and procedures.

Summary of Data Analyses

Using a variety of analytic procedures including independent *t* tests, dependent *t* tests, tests of inter-rater reliability, tests of validity, and focus group questions, PTs experiences with UDL were analyzed. Results capitulated from these data analyses indicated that PTs understanding of

UDL as well as their self-perceived level of confidence in teaching students with varying ability levels increased after viewing VIUDL. Correspondingly, the intervention did not seem to provide a significant impact on PTs knowledge of or their level of application of the UDL principles. Feedback from a small voluntary sample of participants in the experimental group indicated they learned from the videos and that the VIUDL was interesting and informative.

CHAPTER FIVE: DISCUSSION

Introduction

The purpose of this final chapter is to discuss the relationship between the results of the study and the existing literature on lesson planning, teachers perceived confidence levels, and universal design for learning (UDL). The key sections of this chapter summarize implications of the research findings as well as recommendations for future research in these areas and limitations to this study.

As reviewed in chapter two, a considerable amount of literature exists on the research based practices supporting UDL, and the need for a paradigm shift in the way teaching is accomplished. Teaching of UDL concepts within content areas as opposed to isolated instruction in methods classes may be one way to support PTs preparation to serve all students. By taking the knowledge learned from traditional course work to the required skill level needed for application of the principles of UDL in lesson planning PTs will be better prepared to teach students of varying ability levels.

Statement of the Problem

Many developments in the history of special education have led to unforeseen outcomes (Hallahan, Kauggman, & Pullen, 2009). Previous generations of general education teachers often did not work with students with disabilities, and course work was limited to preparing special educators in teacher education programs. The focus of special education was to find and "fix" the student's problem in an isolated environment restricting access to the general education setting (Jackson & Harper, 2001). Society has accepted that education alone cannot "fix" a student as

shown by the alarming statistics that 60% of inmates and 75% of unemployed adults are functionally illiterate and at least 33% of mothers on welfare have identified disabilities (Rumberger & Thomas, 2000).

Potential Solutions

What the field of special education and teacher preparation needs is not to continue to admire the problem but to find solutions. These potential solutions should include a paradigm shift in current practice, improvement in PT preparation, and ensuring the utilization of UDL, including technological innovations for students of varying ability levels.

Preservice teachers need to reconceptualize the process of teaching from the teacher being engaged to students being the center of engagement by creating multiple pathways for students to be successful (Bouillion & Gomes, 2001; McGregor, 2004; McGregor & Guner, 2001; Singer, Marx, Krajcik, & Clay-Chambers, 2000). A paradigm shift from the traditional teacher using the lecture-read-group discussion method in conjunction with a textbook to teach content material to a student-centered learning environment is necessary. These techniques for students with varying learning styles and abilities have not resulted in successful learning outcomes as noted in low graduation rates, high rates of unemployment and underemployment as well as limited post-secondary enrollment for students with disabilities (Horton, Lovitt, & Slocum, 1988). McCoy (2005) suggests that in order to develop and sustain student interest in content areas all students need to be engaged in the process avoiding excessive textbook and lecture dependent learning. Unfortunately, according to the Trends in Mathematics and Science Study (TIMSS) data, fourth grade students noted this type of student-centered engaged learning is not occurring (Martin, Mullis, & Foy, 2007). The current findings indicate "the most frequent science investigation

activities were writing, giving an explanation, and watching teachers demonstrate a science concept (69%)" (p. 296). In fact, internationally, 52% of fourth grade students noted textbooks as the primary source for science instruction (Martin et al.). These findings indicate a paradigm shift is needed for success of all students and perhaps even more critical for students with disabilities.

Although PTs tend to agree that instruction should have less emphasis on textbooks and more on inquiry or hands on learning, the actual level of inquiry-based practice fluctuates (Anderson & Helms, 2001; Crawford, 2000; Darling-Hammond, 1999; Davis, 2003). The reasons for the variation in levels of inquiry implementation consist of, but are not limited to: (a) school climate [including support from administration] (Lynch, 2000; Schwartz, Abd-El-Khalick, & Lederman, 1999), (b) poverty/lack of resources at the school level (Barton, 2001; Bouillion & Gomez, 2001), (c) teachers' comfort level with content being taught (Gess-Newsome, 1999), (d) teachers' beliefs about altering practice (Anderson & Helms, 2001; Haney & McArthur, 2002; Smith, 2005), and (e) teacher's understanding of how to properly implement inquiry learning (Rigden, 1999).

As a result of No Child Left Behind (NCLB, 2001) and the Individuals with Disabilities Education Act (IDEA, 2004), special education is no longer a place for students with disabilities, but rather a system of supports and services allowing greater access to the general education curriculum (Jackson & Harper, 2001). The focus has changed from "fixing" the student to fixing the curriculum and instruction to meet the needs of students with varying ability levels. Consequently, general education teachers today are expected to plan lessons with the objective of students with disabilities accessing the general education curriculum (Jackson, Harper, & Jackson, 2001; Rose & Meyer, 2002). For easy access for all students, general education teachers

must reflect on their current practice and decisively explore how to make the learning more flexible for students of varying ability levels (Jackson & Harper).

Though data support including all students in general education classes (Gable, Hendrickson, & Tonelson, 2000), research indicates that many PTs do not perceive themselves as adequately prepared to provide instruction to students who have disabilities (Kirch et al., 2007; Norman et al., 1998). Similarly, the way general education teachers are currently prepared, and how they design lesson plans has not necessarily changed to account for inclusion of students with disabilities (Lipsky & Gartner). One reason the literature indicates for stagnant change is that PTs tend to perceive themselves as lacking essential skills to plan appropriate instruction for students of varying ability levels (Kirch, Bargerhuff, Turner, & Wheatly, 2005; Norman, Caseau, & Stefanich, 1998). In fact, since many PTs themselves were not in inclusive classes, a point of reference from personal experience is nonexistent (Ingersoll, 2003). The quandary remains of how PTs can change self-perceptions and gain personal experience while obtaining competency in lesson plan development that utilizes research-based practices to meet the needs of students with disabilities.

Preservice teachers are in the process of learning instructional practices and developing their repertoire of lessons. If UDL principles are employed at the beginning of their careers, PTs will not need to retrofit curriculum and instruction. By institutions of higher education (IHE) building these skills into the PT curriculum, the next generation of teachers should be better prepared to teach all students (Lipsky & Gartner, 2004).

A shift in teaching should include utilizing UDL with technology in lesson planning. For example, the mentality that technology is an extension of print-based assumptions and therefore only useful for word processing, calculations, and games (Reinking, Labbo, & McKenna, 2000)

must change to allow for multiple means of action and expression as well as to increase student engagement. Meyer and Rose (1998) add "teaching is all about responsiveness, adaptability, and multiple strategies and resources, so the computer's flexibility – rather than one particular feature- is what gives it so much potential as a teaching tool" (p. 83). As the current generation grows with increasing digital formats teachers need to embrace these new media to enrich and support learning (Jackson, Koziol, & Rudowitz, 2001). Through the impact of technology and the use of UDL in creating lessons, all students will be more likely to have successful learning experiences.

By going from a teacher-centered classroom to a student-centered one, PTs may consider themselves more equipped to meet the needs of students with varying ability levels. Critical to this shift is PTs thinking about the presentation of academic material in a way that may be very different from how they were taught (Biddle, 2006; Lee et al., 2004). This change begins with a belief that positive learning outcomes for all students are possible (Haney, Czerniak, & Lumpe, 1996; Haney & McArthur, 2002).

Review of the Methodology

This study examined PTs knowledge, understanding, and application of UDL as well as self-perceived ability to plan lessons for students of varying ability levels. The video intervention (VI) for the control group was a science content video professionally created by Consumer Aerosol Products Council (CAPCO) titled *Another Awesome Aerosol Adventure.* The video intervention for the experimental group (VIUDL) was also a 10-minute video with the CAPCO footage with parts of the CAPCO video removed and replaced with the principles of UDL for the VIUDL. The intention of the study was to answer three research questions focusing on the

potential impact of learning about UDL in a content area through video instruction. All 86 participants were randomly assigned to either the control of experimental group. The control group was comprised of 41 PTs whereas the experimental group had 45 PTs. The study took place over a single spring semester with four sections of an undergraduate science methods class taught by the same professor at a large urban public university. Of the 109 students enrolled in these four courses, 86 participated in the pretest, intervention and posttest phases to answer research questions one and two. Of the same 86 participants, 75 choose to have lesson plans submitted as part of a class assignment reviewed by the researcher in an effort to answer research question three.

Summary and Discussion

This study attempted to answer three research questions: 1) Does knowledge and comprehension of UDL principles increase when PTs are taught in context with content?, 2) Does preservice teachers' perception o their ability to serve students with disabilities increase when provided video intervention with universal design for learning? 3) Does application of UDL principles increase when taught in context with content?

As suggested in chapter two, substantial literature about research based practices support the philosophy of UDL. The field of special education is beginning to expect teachers to implement UDL principles in their classrooms. As Rose and Meyer (2002) explain "barriers to learning occur in the interaction with the curriculum—they are not inherent solely in the capacity of the learner, thus, when education fails, the curriculum, not the learner, should take the responsibility for adaptation" (p. 20). King-Sears (2001) contributes that general education curriculum can be designed for maximum accessibility using technology allowing for the content to be attainable.

Currently, limited research directs how to specifically bring PTs from a level of knowledge and understanding of UDL to successful application in their daily planning and instruction.

Current Shift in Legislation and Teacher Preparation

At the present time, UDL is not directly referenced in federal K-12 legislation. However, the Assistive Technology Act mentions and defines UDL (29 U.S.C. 3002 §3[19]) and a component of these principles in IDEA 2004 containing the National Instructional Materials Accessibility Standard (NIMAS). These changes demonstrate that legislation is moving in the direction of including UDL in K-12 legislation. Recently, the Ideas That Work Website made available from the Department of Education its *Tool Kit on Teaching and Assessing Students with Disabilities: Universal Design for Learning.*

Even though UDL is not currently mentioned in federal K-12 legislation, it is well-built into the Higher Education Act (HEA, 2008) exhibiting the growing importance to the field. One example is that recipients of federal grants relating to teacher preparation must include in the course work "strategies consistent with the principles of UDL" [P.L. 110-315, §300.172(a)(1)] and that preparation program evaluation and performance measures should include UDL (Sopko, 2009).

Hence, this study is very timely and relevant because IHEs must include UDL principles in their preparation program development (HEA, 2008), yet research is limited showing the most effective techniques for this change to occur. From this study learning about UDL within coursework was not enough for most PTs to have knowledge mastery even though the study was conducted in the last weeks of their course that covers this topic. By adding the component of teaching UDL within the content area with only a ten minute video intervention, higher levels of

understanding emerged in some areas for the experimental group. Institutions of higher education are under obligation by the HEA (2008) to move away from traditional teaching styles and rather to teach using UDL principles. Legislative changes alone will not directly impact teachers' knowledge and understanding (Minow, 2001). Teacher preparation programs need to incorporate MMR, MMA&E, and MME through the use of high and low tech options including digital formats to support learning (Jackson et al., 2001) to increase knowledge, understanding and ultimately application in lesson planning.

The only significant change in PTs in this study was between the control and experimental groups in the understanding of principle II, MMAE (see Table 14). The video provided a visual example of the most abstract of the three principles. Seeing MMAE in action may have allowed for the PTs to more fully grasp the concepts as demonstrated by a statistically significant difference when comparing the control and experimental groups' scores. However, one can speculate that by having this abstract idea presented in a way that encouraged thinking about how the PT would implement MMAE it may have increased self-confidence levels for teaching students of varying abilities.

This one finding reminds the field of teacher education that PTs need courses and professional development that encompasses modeling of UDL in K-12 situations. The researcher in the design of this study attempted to use all three UDL principles. As a direct result of this study emphasizing the use of UDL, the researcher ensured that the three principles were incorporated as often as possible while maintaining fidelity. This research may provide a model of not only integration of UDL, but how the field may utilize these strategies during the research process. Within this study the three principles of UDL were integrated in the following ways.

Principle I: provide multiple means of representation (the "what" of learning)

- The pre and posttest could be taken online (which allowed for options of perception i.e., larger text, color differentiation of text, text to speech software to read survey to participant) or in paper format.
- The intervention video
    - provided options for language and symbols – all key concepts were written out within video, explained, demonstrated, and reviewed and given in paper form in viewer's guides
    - provided options for perception - had close captioning so that participants - could read and/or listen to the video and had dialogue describing any pictures that appeared in the video and through the viewer's guides
    - Provided options for comprehension – an advanced organizer allowed for knowledge of the goals of the video, information processing was guided through explanations, followed by examples, then a repeating of the information through the viewer's guides
- Lesson plan
    - provided options for language and symbols – all information was given orally, in writing, and used technology allowing for access to the information

Principle II: provide multiple means of expression (the "how" of learning)

Due to the nature of research studies and to account for fidelity, the options relating to physical actions, expressive skills and fluency, and executive functions were limited. All

participants did their lesson plans on the same topic using the same format. However, the PTs were given the option of the prewriting activity online to assist in scaffolding practice and performance. Additionally the viewer's guides facilitated managing information and resources related to the entire study.

Principle III: provide multiple means of engagement (the "why" of learning)

Again, principle III had limited exposure during the study. However, the relevance, value and authenticity of this research provided options for recruiting interest, which is shown in the high participation rate. Correspondingly the participants in the focus group questions reflected not only on the intervention, but on their learning. By providing viewer's guides, and a prewriting activity, there were varying levels of challenge and support for students who choose to use them. Using throughout the study this type of planning and implementation of UDL principles, creates a shift in teacher education and research that both embraces and models these practices.

Improving Preservice Teacher Preparation

IDEA 2004 language states that teachers must "have the content knowledge and skills to serve children with disabilities" (IDEA, Sec. 300.156, 2004). Yet, according to National Association of State Directors of Teacher Education and Certification (NASDTEC) (2003) new general educators are not considered to be highly qualified in regards to teaching students with disabilities. This statement reflects a national perspective and does not take into account pockets of programs within states that require dual certification or districts where teachers are considered life-long learners as they are required to take annual professional development to improve their craft. None the less, a major concern is the preparation of general education teachers since as an

outcome of LRE language, almost 50% of students with disabilities are spending 80% or more of their time in general education settings (USDOE, 2004).

Findings from this study support this concern for general education teacher preparation and continue to add to the research. Not only do PTs fail to have a firm grasp of understanding and application of UDL in their lesson plans, but as a group, they also do not have the self-perceived confidence level to teach students of varying ability levels even though they are considered highly qualified by the state. In other words, IHEs are not doing enough to fully prepare PTs for the profession to serve all students (Darling-Hammond, 2003; Norman et al., 1998; Vaughn et al., 2000)

One way to increase the application of UDL as well as increase self-perceived confidence levels of teaching may be to increase the focus in teacher preparation on the use of technology in the classroom (Edyburn, 2006; Judson, 2006). Edyburn (2009) states "UD[L] is proactive instructional design that seeks to build learning environments and instructional materials with [technological] supports (e.g., text that talks, language conversion, cognitive simplification, dictate responses rather than handwrite, alter font size, etc.) that enable all students to achieve the academic standards despite differences" (n.p.). By making technology (specifically related to UDL) part of the teacher preparation requirements, teachers should be equipped to support students with disabilities accessing the same academic standards as their nondisabled peers. Although this study did not focus on the topic of increasing technology use, it became a reoccurring theme as the study progressed, one IHEs need to consider in teacher preparation.

Universal Design for Learning, Technological Innovations

Reith and Polsgrove (1998) aptly state, "It is not enough to merely place students with [disabilities] in general class settings without providing appropriate training, materials, and support to them and their teachers. To do so surely invites their failure" (p. 257). Therefore, research supports a need for stronger preparation of general education teachers (Darling-Hammond, 2003). Currently IHEs often do not demonstrate "best practice" that they teach by failing to evaluate their own materials and procedures to ensure optimum learning occurs for PTs (Ellis et al., 1989). By not providing the necessary tools for PTs to meet a wide range of learners IHEs are permeating status quo and not contributing to a needed paradigm shift in PT knowledge, application and most importantly practice. The approach often appears to be, I will teach one way and you will learn this way – instead of focusing on the objective being met through fluid use of materials, methods, and assessments with multiple means of representation, expression, and engagement (Rose & Myer, 2002).

Interestingly, the personnel preparation program for doctoral students in special education at the large urban university where this study occurred models, for future teacher educators, the UDL approach. For example, all doctoral students are certified to teach on-line courses after completing a semester long class from the Advancement of Distributed Learning (ADL). During this course, faculty and doctoral students learn the basics of designing curriculum and classes for online and mixed method sections of traditionally face-to-face classes. Additionally, each doctoral student co-teaches an undergraduate or masters level course that is either online or mixed mode with a member of the faculty. From this experience the doctoral student learns about multiple ways to represent material in online classes as well as various modalities for teaching

content and assessing student learning. In some cases, doctoral students have opportunities to take content and make it UDL. One such opportunity was with a grant funded project to create modules for the purpose of assisting current special educators to pass the mathematics content teaching exam, whereas another was assisting to develop and test a new course format with Adobe Connect. One advantage to these opportunities at the doctoral level is that much like PTs, doctoral students while still taking classes are still developing notions about how they want to teach their students. Therefore, the time to learn about technology and think about paradigm shifts is while still in the learning phase as opposed to never using or having to retrofit these ideas into practice after the fact.

Both teacher education and teacher practice need to shift to a more fluid design embracing UDL. The paradigm shift required by NCLB focuses on (a) hands-on activities (Amaral, Garrison, & Klentschy, 2002), (b) collaborative groups (Pedrosa de Jesus et al.), and (c) more generalizable then decontextualized content knowledge (Merino & Hammond, 2001; Rodriguez & Bethel, 1983). In addition, the HEA requires faculty to embrace UDL principles in program development. Nevertheless, with IHEs moving towards an increasing number of classes online the difficulty becomes how to model and evaluate each of these three focuses of NCLB. For example, "a teacher who firmly believes that the best way for students to learn content is through informative teacher-delivered lectures will give little consideration to the idea of using technology as means for student exploration" (Judson, 2006 p. 583). Judson goes on to discuss that fear and attitudes toward technology may result in lessons that are more traditional in style. As the current generation increasingly embraces digital formats, teachers need to incorporate these new media to enrich and support learning (Jackson, Koziol, & Rudowitz, 2001). However, it is important to remember that UDL is not simply multimedia, but rather access to curriculum.

Perhaps the most important contribution to the field from this study does not come from data outcomes, but rather from lessons learned while attempting the study with the pilot group online. When participants are not face-to-face with the researcher, fidelity of treatment is difficult to control. For example, in this study there was no way of knowing if in fact the participants watched the VI or VIUDL. Since the treatment was the video, the study would not have been able to be completed. Additionally, UDL is not an intuitive process for teachers as they may have never experienced this style of learning. Making the design of the study UDL may have increased confusion levels for some participants. The confusion was confounded by not being able to have immediate feedback to questions that may have risen during the data collection process. All of these concerns were addressed with the SCE 3310 classes by the researcher conducting the study face-to-face. However, these are interesting dilemmas that the field needs to address as the shift towards online learning increases in teacher preparation (Rose & Myer, 2002).

Universal Design for Learning and Improved Preservice Teacher Preparation

Utilizing the principles of UDL allows PTs to address varying student abilities by means of building accommodations and student choices into each lesson. By meeting students' needs during the planning stage of lesson development (as opposed to revising when an accommodation must be met) allows for the maximum number of students to benefit from instruction without the need to retrofit each lesson taught (Okwis & McLane, 1998). So, then if it is known that UDL has positive student outcomes and is required to be taught according to the HEA, then why are PTs not learning how to successfully apply UDL when planning and teaching? The answer may lie in the tools the IHEs are using to teach about UDL.

For example, the participants in this study were all concurrently enrolled in EEX 4070, a class with a syllabus made up of choices, MMR, MMA&E, and MME. The students had knowledge of UDL as this skill was modeled weekly. Students in EEX 4070 were required to build lesson plans using the lesson plan builder application on the CAST website and during the pretest could answer the majority of the multiple choice questions relating to UDL correctly. Yet, during the last few weeks of the semester, when the pretest was given, the majority of students could not give an appropriate answer to "What is universal design for learning." Yet, interestingly, a simple 10 minute VI in which UDL was modeled in a content area provided cognitive links necessary to allow these teachers to demonstrate on the posttest a level of understanding in some areas of UDL.

So the question remains, what tools are necessary to bring PTs to an even higher level of learning, application? The answer is obviously not a 10 minute video alone, but could lie in assuring that information is accessible and engages student's cognition to a level that makes application relevant. The only way to increase accessibility and relevance is to take what is already occurring in classes like EEX 4070 and take it to the next level of showing what it looks like in a K-12 classroom. Then, the approach must be utilized and generalized in all teacher preparation classrooms not only through discussion and in class application (as with choices within assignments and representing content in various ways), but through demonstration and modeling of proper use for school age children (What would choices look like at grade 2 vs. grade 7?; How can a standard lab report be represented to students at varying ability levels?).

Implications for Practice

As a field, it is known that knowledge is the lowest level of learning and is often accomplished in classrooms settings or with reading of materials. The increase in both the control and experimental groups' scores from pre to posttest was not surprising and is congruent with the literature on learning (Bloom, Hastings, & Madaus, 1971).

Understanding, the second level of learning in Bloom's taxonomy, requires articulation of exactly what is understood. Again, this study's findings were consistent with the research. Since the experimental group not only learned about UDL, but had it modeled and explained in VIUDL, it is logical that the participants in the experimental group's level of understanding of the concepts of UDL increased.

Simply increasing knowledge and understanding of concepts is not what is important. Application of the knowledge and understanding to appropriate situations and contexts is the key. Currently, the field of education often does not incorporate tools at the teacher preparation stage that allows for PTs to make the leap from knowledge and understanding to the application level in many courses. Research supports a need for stronger preparation of general education teachers (Darling- Hammond, 2003).

The fact that this study showed no statistically significant difference between the control and experimental groups' lesson plans was not surprising since the PTs did not have the opportunity to practice and receive feedback on their application of the UDL principles. Thereby a paradigm shift did not occur in the way teachers view themselves or their practice (Lee et al., 2004). Through use of only a video intervention, teacher-centered learning may have actually been reinforced, as opposed to allowing for the PTs to shift their thinking to more student-centered learning (McGregor, 2004). McCoy (2005) suggests that in order to develop and

sustain interest in a topic students (in this study PTs) need to be engaged in the process to be brought to the application level. In addition to simply a paradigm shift in PTs' roles in the classroom, opportunities should be provided for PTs to have relevant skill application (Kennedy, 1998; Loucks-Horsley, Hewson, Love, & Stilers, 1998). In fact, in the opinion of the researcher, teacher preparation needs to include modeling, practice, and active feedback on a regular and consistent basis throughout PTs programs in order to successfully apply topics with confidence and fidelity.

The continued paradigm shift in teaching is necessary and has implications beyond special education. In fact, it is students of all ability levels, including gifted, who stand to benefit from UDL principles (Rose & Meyer, 2002) being infused into teacher preparation programs. Preservice teachers thinking about students with disabilities and technology must shift starting with how lesson plans are developed. For example, the mentality that technology is an extension of print-based assumptions and therefore only useful for word processing, calculations, and games (Reinking, Labbo, & McKenna, 2000) must change to allow for multiple means of action and expression as well as to increase student engagement.

Preservice teachers need to make a paradigm shift prior to entering the field to be more student-centered including the use of technology as means for MMR, MMAE, and MME. By implementing this shift in thinking while at the teacher preparation level, PTs can see models that every member of their college level course benefits from UDL without stigmatizing different learning styles and abilities (Scott, McGuire, & Shaw, 2003).

Recommendations for Future Research

Universal design for learning is not a passing trend in education but a core principle to guide teachers in serving the range and diversity of learners in today's classroom. In fact, UDL is receiving increased references in policy as well as in teacher education programs. Evidence appears within IDEA in the Assistive Technology Act (Sopko, 2009) and more recently in the 2008 Higher Education Opportunity Act (HEOA). Specifically, HEOA states "*TEACHING METHODS AND STRATEGIES.*—The development of innovative, effective, and efficient teaching methods and strategies, consistent with the principles of universal design for learning…" [P.L. 110-315, §762(b)(2)(A)]. Therefore, now is a time of determining the most effective way to not only teach methods and strategies about UDL; but to demonstrate, practice, and implement these prinicples in PTs preparation programs. "Teacher preparation programs often incorporate many examples for ways students can engage in the content and express what they learned through multiple assessment methods, but the majority of faculty across the university continue to teach how they were taught—primarily through lecture" (Sopko, 2009 p. 6). For that reason, additional research is needed on how to best work with PTs to ensure that their knowledge and understanding of UDL undergoes significant nurturing to accomplish application of all three principles.

Future research specifically related to advanced technological mediums for delivery of content is necessary as digital natives become the primary consumer for today's teachers. Examples include utilizing features of Web 2.0 and having modules with embedded video modeling, interactive case studies as well as synchronous and asynchronous learning for online users will all increase learning capabilities. The use of technology such as virtual environments to practice the application of skills, and exploring portable technologies such as the iPod touch

should also be explored. Ogilvie (2008) states "the availability of increasingly sophisticated although relatively simple to use technology, i.e. iPods, video phones, digital cameras, etc., provides increased access to video modeling as a tool" (p. 31).

Recommendations for future research include determining how teaching UDL within content areas impacts student application and confidence level. Specifically, does teaching of UDL outside of the context of special education have broader impact on PTs application of UDL?

Limitations

Several limitations were addressed as a result of the pilot study and subsequent changes to study protocol. Yet other limitations to this study emerged. The following provides limitations related to the findings.

One limitation of the study dealt with the pre and posttest data. Since not all participants took the pretest online prior to coming to class, many completed a paper copy. Although the pretest was the same, having a paper copy allowed respondents to look back at previous pages, something not allowed in the online version. Similarly, participants could leave the open ended questions blank, not allowing the researcher to know if the respondent did not know the answer to the question (directions stated if you do not know the answer please write "I don't know") or if the respondent simply missed the question or did not feel like answering it. Another limitation of the paper test was when respondents were to pick only three correct answers out of nine choices given. In the online version, the active radial buttons only allowed three answers to be selected, however with the paper version several participants were unclear of how to answer the question as was noted in chapter four.

Originally, all data collection and interventions were to be completed online. However, in the pilot study fidelity in an online environment was an issue, so the researcher showed the appropriate intervention video in person for each of the control and experimental groups in all four classes. The researcher took participant attendance prior to showing the video in order to ensure fidelity. Although this procedure was not necessarily a limitation to this study, it has a potential to be a large limitation if replicating with online classes or if a larger *n* were to occur. If replication of this study is to occur in an online environment the researcher suggests determining if the protocol in Figure 19 can be established prior to beginning the study.

Yes / No	Can the following be established with the online class?
	Is material presented in a location on the class site that is intuitive for students?
	Is the time of the study during the semester going to affect outcomes?
	What other classes are students enrolled in while in the class participating in study?
	Are there times that the class can meet synchronously to ensure fidelity of treatment?
	Is the technology used for data collection going to influence data outcomes?
	What role the researcher has compared to the professor in relaying study information?
	Is there a backup plan for issues with technology? How will these be presented to participants?

Figure 19: Online protocol checklist

Another limitation of the study was determining the extent of application that occurred since the PTs did not yet have their own classroom and therefore were only able to respond to a simulated environment. Therefore, the PTs results of the lesson plan on applying the principles of UDL may suggest "the formation of transfer environments are not assumed to be an actual part of the process, but rather are seen as differentially supporting or interfering with it" (Beach,

2003, p. 40). An additional limitation with the lesson plans was discovered after the conclusion of the study. The participants had been assigned the lesson plan assignment by their SEC 3310 professor but during the same time frame, they were also assigned by their EEX 4070 professor to find a science lesson on line that could be adapted for an in-class assignment. Based on the similarities among lessons turned in, the conclusion of the researcher is that the participants may have used the lessons found online for both classes with varying degrees of modifications.

Finally, there were limitations with the focus group. One issue was the timing during which the focus groups were to occur, the week after the semester ended. A second issue was contacting people from only the experimental group since no identifying information was collected up to this point ensuring confidentiality. In retrospect, the researcher should have recruited for the focus group on the final day of each class for the semester by asking for students to self disclose their email addresses if they were interested in participating in the focus group. However the email did provide positive feedback from participants in both the control and experimental groups.

Final Conclusions

Limited changes occurred but some positive results were found. Preservice teachers who had an entire course taught using UDL seem to have had an "ah ha" moment of how to implement these principles at the K-12 setting after watching the 10 minute video. The underlying theme of technology use in IHEs emerged as an area in need of further research by the field. The researcher learned about limitations of online research fidelity that have not been explored in-depth in the research and grew in the areas of video modeling and development. Additionally, an improved level of self-confidence to teach students of varying ability levels occurs when

application is modeled using video. Finally, the research base for how to teach PTs in order to increase their knowledge to levels of understanding the principles of UDL has been increased.

As legislation increasingly spells out the need for teachers to utilize UDL in classrooms, it becomes a rising issue as to how best ensure the application of UDL. Three possible solutions are a paradigm shift in current practice, improving preservice teacher preparation and ensuring the utilization of universal design for learning including technological innovations all of which may be completed with video modeling. One participant stated, "I really enjoyed the film, it has been awhile since I saw it, but I remember it helping me to better grasp what the concept of UDL was. In the course that we were taking at the time, UDL seemed like this really large undertaking, the video helped to illustrate the ways in which to break it (any subject really) down so the topics don't have to be so overwhelming." Demonstrating that UDL does not have to be overwhelming at any level in education and in fact may save time, energy and most importantly our student learning when implemented consistently from early intervention to higher education.

APPENDIX A:
PRE AND POST TEST

Page #1 Edit PageMoveCopyDeleteAdd Logic Show this Page Only

1. Default Section

Add Question Here

Edit QuestionMoveCopyDelete

Thank you for taking this survey.

By submitting your answers to this web-based survey, you are giving informed consent of participation and stating you are 18 years of age or older.

This is not a test; you will not be graded on your responses and they will have no effect on your course grade.

You should take part in this study only because you want to participate. There is no penalty for not taking part, and you will not lose any benefits. You have the right to stop at any time. Just tell the researcher or a member of the research team that you want to stop. You will be told if any new information is learned which may affect your willingness to continue taking part in this study.

Risks: There are no expected risks for taking part in this study. You do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks.

Benefits: As a research participant you will not benefit directly from this research, besides learning more about how research is conducted.

Compensation or payment:
There is no compensation or other payment to you for taking part in this study.

Confidentiality: Your identity will be kept confidential. The researcher will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from the information you give, and these two things will be stored in different places for no longer than five years before data is destroyed.

Study contact for questions about the study or to report a problem Sara Aronin, College of Education, [redacted] or by email at [redacted] or my primary advisor, Dr. Lisa Dieker by email at [redacted].

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

Add Question Here

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Page #2 Edit PageMoveCopyDelete

2.

Please enter your participant number provided by your professor. If you do not have a participant number, please contact your professor prior to proceeding. *

1. Code is for tracking purposes in the study to maintain confidentiality.

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3.

If you do not know the answer, please write "I do not know"

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*

1. Please summarize your understanding of Universal Design for Learning.

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*

1. Which of the following are the three core principles of universal design for learning (UDL)?

	Answer 1	Answer 2	Answer 3
multiple kinds of graphic organizers	Answer 1	Answer 2	Answer 3
multiple kinds of representation	Answer 1	Answer 2	Answer 3
multiple kinds of mnemonics	Answer 1	Answer 2	Answer 3
multiple kinds of evaluation	Answer 1	Answer 2	Answer 3
multiple kinds of engagement	Answer 1	Answer 2	Answer 3
multiple kinds of expression	Answer 1	Answer 2	Answer 3
multiple kinds of grouping	Answer 1	Answer 2	Answer 3
multiple kinds of teacher questioning	Answer 1	Answer 2	Answer 3
multiple kinds of hands on learning	Answer 1	Answer 2	Answer 3

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5.

If you do not know the answer, please write "I do not know"

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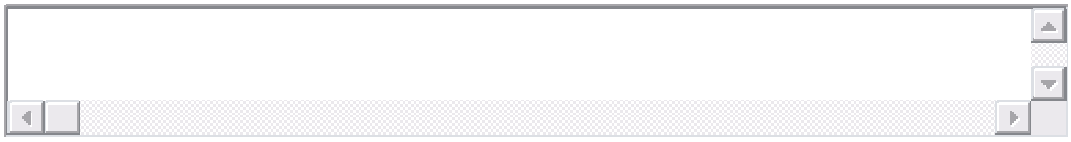
*

1. Describe your understanding of multiple means of representation and how it relates to designing curriculum.



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*

2. Describe your understanding of multiple means for action and expression as well as how it relates to designing curriculum.

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*

3. Describe your understanding of multiple means for engagement and how it relates to designing curriculum.

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6.

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1. Universal Design for Learning (UDL) is an approach that focuses on—

- using technology in the classroom.
- expanding the capacity of curriculum by ensuring that it is more flexible and responsive.
- modifying state standards to make them more achievable by a greater number of students.
- modifying curriculum only for students with disabilities.

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2. UDL requires educators to make a paradigm shift to focus on —

- using technology-based tutorials to increase student learning abilities.
- identifying learning strengths and challenges of students.
- designing customized adaptive technology solutions.
- identifying strengths and challenges inherent in the curriculum.

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3. UDL supports—

- high expectations only for students with disabilities.
- high academic standards for all students.
- one universal way for all students.
- one form of assessment for all students.

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4. UDL and assistive technology are distinct because the latter focuses only on the needs of the—

- cooperative learning group.
- instructor.
- individual student.
- administrator.

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5. Universal Design for Learning supports maintaining challenge while eliminating barriers to—

- getting high grades.
- curriculum.
- in-class contributions.
- assignment completion.

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6. Students who are unable to meet basic course requirements because the materials are inappropriate for them, or because they cannot express themselves well either verbally or in writing, will—

- be better off exploring vocational training.
- benefit from some extensive tutorials to increase their learning abilities.
- benefit from increased opportunities in using flexible curriculum.
- experience less frustration if they didn't set their sights so high.

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7.

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1. If lesson goals or objectives are open-ended and without the means embedded, teachers have—

- more latitude to be flexible in their selection of methods, materials, and assessments.
- less ability to maximize learning opportunities.
- the responsibility to administer additional assessments.
- to spend more time retrofitting the curriculum.

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2. When selecting materials for a lesson teachers should

- wait until school begins to understand their students learning needs
- use a range of materials to support each of the three brain networks
- limit the range of materials they use to ensure that all students receive information in the same way
- only use materials that are designed to support students with disabilities.

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3. When deciding what methods to use for teaching lessons, teachers should

- vary their teaching techniques to ensure students strengths are represented
- primarily lecture since this is the most expedient and there is a plethora of information that needs to be covered
- always use visuals since students of today are engaged by visual representations
- only use materials that are designed to support students with disabilities.

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4. When deciding what assessments to use in their classrooms, teachers should

- ensure that assessments measure the goal and are flexible and ongoing
- always provide students with choices about which assessment they want to take
- ensure that assessments are similar to guarantee student progress is measured
- only use assessments that have been approved by the state

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5. UDL curriculum

- maximizes learning for all students
- primarily supports students with challenges
- does not focus on gifted students since they understand what is being taught and do not need additional supports
- helps teachers assess the strengths and weaknesses of all of their students.

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6. When designing curriculum using the UDL lens, teachers should

- think "Flexibility"
- only use technology
- wait until they know their students
- never use print text

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8.

1. Please rate your confidence level for performing the following teaching tasks in elementary science with students of varying ability levels.

	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for perception	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for language and symbols	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for comprehension	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for physical action	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for expressive skills and fluency	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for executive functions	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for recruiting interest	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for sustaining effort and persistence	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide options for self regulation	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared

Provide multiple means of representation	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared
Provide multiple means for action and expression	completely unprepared	somewhat unprepared	adequately prepared	somewhat prepared	completely prepared

Add Question Here
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9.

1. Please rate how much you agree or disagree with the following statements

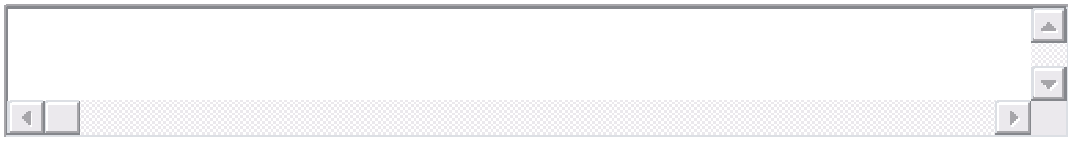
	strongly agree	agree	disagree	strongly disagree	not certain
Aerosol products such as hairspray and spray deodorants can be bad for the environment	strongly agree	agree	disagree	strongly disagree	not certain
Aerosol products are useful	strongly agree	agree	disagree	strongly disagree	not certain
Aerosol products harm the upper ozone layer	strongly agree	agree	disagree	strongly disagree	not certain
Aerosol containers can be recycled	strongly agree	agree	disagree	strongly disagree	not certain
Most of today's aerosol products made or sold in the US contain CFCs	strongly agree	agree	disagree	strongly disagree	not certain
There was a "hole" in the upper ozone layer	strongly agree	agree	disagree	strongly disagree	not certain
The upper ozone layer is progressively healing itself	strongly agree	agree	disagree	strongly disagree	not certain

Add Question Here

10.

If you do not know the answer, please write "I do not know"

1. What causes the seasons for regions of the earth that experience winter, spring, summer, and fall?



11.

1. Demographics

	Age	Ethnicity	Gender	Desired Grade Level	During this semester are you taking EEX 4070 with	This semester, are you taking SCE 3310 with Dr. George Roy?
Please tell about yourself						

APPENDIX B:
INSTRUCTIONAL REVIEW BOARD DOCUMENTATION

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

EXPEDITED CONTINUING REVIEW APPROVAL NOTICE

From : **UCF Institutional Review Board**
FWA00000351, Exp. 10/8/11, IRB00001138

To : **Sara A. Aronin**

Date : **January 27, 2009**

IRB Number: **SBE-08-05395**

Study Title: **NASA Workshops and Inclusion: Challenging Teacher Beliefs About Inclusion in Content Areas Through Interactive STEM Modules**

Dear Researcher,

This letter serves to notify you that the continuing review application for the above study was reviewed and approved by the IRB Chair on **1/27/2009** through the expedited review process according to 45 CFR 46 (and/or 21 CFR 50/56 if FDA-regulated).

Continuation of this study has been approved for a one-year period. The expiration date is 1/26/2010. This study was determined to be no more than minimal risk and the category for which this study qualified for expedited review is:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Use of the approved, stamped consent document(s) is required. The new forms supersede all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Use the Unanticipated Problem Report Form or the Serious Adverse Event Form (within 5 working days of event or knowledge of event) to report problems or events to the IRB. Do not make changes to the study (i.e., protocol methodology, consent form, personnel, site, etc.) before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 01/27/2009 03:50:03 PM EST

Janice M Turchin

IRB Coordinator

APPENDIX C:
CONSENT FORMS

On first page of online survey via Surveymonkey.com

Thank you for taking this survey.
By submitting your answers to this web-based survey, you are giving informed consent of participation and stating you are 18 years of age or older.
This is not a test; you will not be graded on your responses and they will have no effect on your course grade.
You should take part in this study only because you want to participate. There is no penalty for not taking part, and you will not lose any benefits. You have the right to stop at any time. Just tell the researcher or a member of the research team that you want to stop. You will be told if any new information is learned which may affect your willingness to continue taking part in this study.
Risks: There are no expected risks for taking part in this study. You do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks.
Benefits: As a research participant you will not benefit directly from this research, besides learning more about how research is conducted.
Compensation or payment: There is no compensation or other payment to you for taking part in this study.
Confidentiality: Your identity will be kept confidential. The researcher will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from the information you give, and these two things will be stored in different places for no longer than five years before data is destroyed.
Study contact for questions about the study or to report a problem Sara Aronin, College of Education, [redacted] or by email at [redacted] or my primary advisor, Dr. Lisa Dieker by email at [redacted].
IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.
Please enter your participant number provided by your professor. If you do not have a participant number, please contact your professor prior to proceeding.
Code is for tracking purposes in the study to maintain confidentiality.

University of Central Florida IRB
IRB NUMBER: SBE-08-05395
IRB APPROVAL DATE: 1/27/2009
IRB EXPIRATION DATE: 1/26/2010

Informed Consent for interview/focus group

Dear Educator:

I am a graduate student at the University of Central Florida. As part of my coursework, I am conducting research regarding teachers' perception of competency in lesson planning for use with students of varying ability levels. The study will explore preparing general education preservice elementary teachers to serve students of varying ability levels in their classrooms by gaining knowledge/ understanding and practicing application of UDL principles in lesson planning through the use of a video model. I am asking you to participate in this interview and/or focus group and/or observation because you have been identified as being in the experimental group for the first part of the study. Interviewees will be asked to participate in an interview lasting no longer than 30 minutes. You will not have to answer any question you do not wish to answer. Your interview, focus group, and/or observation will be done through adobe connect and you have the option of participating through use of a webcam, microphone, or instant messaging. With your permission, I would like to audiotape this interaction. Only the primary researcher will have access to the tape, which the researcher will personally transcribe, removing any identifiers during transcription. The tape will be erased after transcription is complete. If you choose to use instant messaging, there will be a written transcription of everything written. All information will be stored in a password protected file. Your identity will be kept confidential and will not be revealed in the final manuscript.

There are no anticipated risks, compensation or other direct benefits to you as a participant in this interview/ focus group/ observation. You are free to withdraw your consent to participate and may discontinue your participation at any time without consequence. Your instructors will not have access to any information obtained and your grades will therefore not be affected by participation.

If you have any questions about this research project, please contact me at [redacted]. My faculty supervisor Dr. Lisa Dieker may be contacted at [redacted] or by email at [redacted].

Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (IRB). Questions or concerns about research participants' rights may be directed to the Institutional Review Board Office, IRB Coordinator, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246. The telephone numbers are (407) 882-2276 and (407) 823-2901. The office is open from 8:00 am to 5:00 pm Monday through Friday except on UCF official holidays.

Please sign and return this letter. A copy is available for your records upon request. By signing this letter, you give me permission to report your responses anonymously in the final manuscript to be submitted to my faculty supervisor as part of my course work as well as to be submitted for possible publication.

Sincerely,

Sara Aronin, M.Ed. Exceptional Education Lisa Dieker, Ph.D. Special Education

---

____ I voluntarily agree to participate in the interview/focus group/observation.

____ I agree to be audio taped during the interview/focus group/ observation.

____ I agree to be video taped during the interview/focus group/ observation.

____ I understand that if I choose to use instant messaging that there will be a written transcription of all interactions.

/

Participant Date

University of Central Florida IRB
IRB NUMBER: SBE-08-05395
IRB APPROVAL DATE: 1/27/2009
IRB EXPIRATION DATE: 1/26/2010

APPENDIX D:
LESSON PLAN ASSESSMENT

Lesson Plan Activity

If you have any problems with any of these three steps, please feel free to contact me at saronin8@hotmail.com

First, watch the 2 minute free video from BrainPop on reasons for the seasons at [redacted]

Next, go to the following website and complete the prewriting activity – it will take you 6 minutes as it is timed. Please complete this prior to 4/26.

http://www.surveymonkey.com/s.aspx?sm=WKWjP2itjKm2FH98nl_2bBbg_3d_3d

Since the link is so long, [redacted] will email you a copy of this page so you can either cut and past the link or click on the link while pressing the control key.

Finally, create a lesson plan (to be turned in during class on 4/28) for maximum instructional effectiveness utilizing the content from the reasons for the seasons video (teaching why we have seasons) and universal design for learning. The lesson plan should be written with enough detail that anyone could pick it up and teach your class. Your lesson plan should include sections for -

I Materials

II Methods

A. Background/ prior knowledge

B. The teaching of new concepts

C. Practice

III Assessment

APPENDIX E:
LESSON PLAN RUBRIC

Lesson Plan Rubric

If blank – 0	1	2	3
Materials	Standard Classroom Books, texts, paper, pens, markers, scissors, glue, rulers, tape, stapler	Technology Anything with a battery, electrical cord, or solar panel	Visual / Auditory/ Tactile Has materials for all 3 types of learners
Procedures *Prior Knowledge*	Includes at least 1 activity with background information	At least 2 activities with background information	3 or more activities with background information
Teaching of New Concepts	No specific content and No RBP	Specific content mentioned OR RBP	Specific content mentioned using RBP
Practice/Formative Assessment	Includes at least 1 activity for practice/ guided learning/ or formative assessment	At least 2 activities with practice/ guided learning/ or formative assessment	3 or more activities with practice/ guided learning/ or formative assessment
Assessment	Independent written assignment OR Test	Working in groups of 2 or more OR Class assigned an independent non written assignment	Menu of Choices
Representation	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines
Expression	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines
Engagement	Uses 1 of UDL Guidelines	Uses 2 of UDL Guidelines	Uses 3 or more UDL Guidelines

I. Provide multiple means of representation - Knowledge Networks	
1. Provide options for perception	**Your Ideas**
• Customize the display of information	
• Provide alternatives for auditory information	
• Provide alternatives for visual information	
2. Provide options for language and symbols	**Your Ideas**
• Define vocabulary and symbols	
• Clarify syntax and structure	
• Decode text and mathematical notation	
• Promote cross-linguistic understanding	
• Illustrate key concepts non-linguistically	
3. Provide options for comprehension	**Your Ideas**
• Provide or activate background knowledge	
• Highlight critical features, big ideas, and relationships	
• Guide information processing	
• Support memory and transfer	
II. Provide multiple means for action and expression - Strategic Networks	
4. Provide options for physical actions	**Your Ideas**
• Provide varied ways to respond	
• Provide varied ways to interact with materials	
• Integrate assistive technologies	
5. Provide options for expressive skills and fluency	**Your Ideas**
• Allow choices of media for communication	
• Provide appropriate tools for composition and problem solving	
• Provide ways to scaffold practice and performance	
6. Provide options for executive functions	**Your Ideas**
• Guide effective goal setting	
• Support planning and strategy development	
• Facilitate managing information and resources	
• Enhance capacity for monitoring progress	
III. Provide multiple means for engagement - Affective Networks	
7. Provide options for recruiting interest	**Your Ideas**
• Increase individual choice and autonomy	
• Enhance relevance, value, and authenticity	
• Reduce threats and distractions	
8. Provide options for sustaining effort and persistence	**Your Ideas**
• Heighten salience of goals and objectives	
• Vary levels of challenge and support	
• Foster collaboration and communication	
• Increase mastery-oriented feedback	
9. Provide options for self-regulation	**Your Ideas**
• Guide personal goal-setting and expectations	
• Scaffold coping skills and strategies	
• Develop self-assessment and reflection	

APPENDIX F:
LETTER TO USE VIDEO

From: Bill Lafield
Sent: Thursday, January 15, 2009 3:10 PM
Subject: RE: Inquiry from CAPCO website - Permission for use

Sara,

I have replaced Rick Morris as the contact for the Consumer Aerosol Products Council, and he forwarded me you request to use the CAPCO video Another Aerosol Adventure and the accompanying lesson plan in your doctorial dissertation.

CAPCO has no problem with your use of this material as described in your email below. We would be very interested in seeing your video demonstration of UDL instructional methods and would gladly provide you with any additional information about the CAPCO educational program that might be helpful. My contact information is:

Bill Lafield
[redacted]

Please give me a call if you need additional information. I would appreciate your keeping me updated on the progress of your project. Thanks!

Bill Lafield
CAPCO Consultant
[redacted]

-----Original Message-----
From: Sara Aronin
Sent: Tuesday, January 13, 2009 4:06 PM
To: Rick E. Morris
Subject: Inquiry from CAPCO website - Permission for use

Dear Rick Morris,

I am a doctoral candidate in the college of education at the University of Central Florida in the process of writing my dissertation on; "Increasing pre service teacher's comprehension and application of universal design for learning (UDL) in science lesson plans."

In order to bring the preservice teacher's knowledge to the comprehension and application level of the use of UDL, I will be making a video demonstrating UDL instructional practices in how to utilize a non-interactive technology (video) with multiple means of expression, engagement, and action.

I am writing for permission to use the movie "Another Awesome Aerosol Adventure Video" for the above mentioned research project. The reason I am asking to use this particular video is because it has content validation as well as being wonderfully elementary school friendly. I would not change any of the content, simply add a student narrator explaining all of the UDL characteristics of the movie as well as adding probing questions for the preservice teachers to think about when writing lesson plans.

The finished movie will be sent to CAST (www.CAST.org) for validation of the UDL content and to a professor at UCF for technical editing. I would also be happy to share the final version with you.

For my study the video would be seen by approximately 250 preservice elementary teachers. I would also like to share with these preservice teachers the lesson plans in your Teachers Kit.

Thank you in advance for your time and consideration and I hope to be working with you in the future. Feel free to contact me with questions or for more information at [redacted] or by email at [redacted].

Sara Aronin
University of Central Florida

APPENDIX G:
VIEWER'S GUIDE CONTROL GROUP

Aerosol Cans &
Universal Design for Learning (UDL)

- Instead of having an accommodation for a single student, that accommodation now becomes an option that all of the students in the class may utilize.

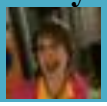
- By using the 3 principles of UDL in lesson plans, teachers have a plan for learning that accounts for abilities of all learners as well as promoting student awareness of different ways to learn.

	Provide Multiple Means of;
Principle I	**Representation**
Principle II	**Expression**
Principle III	**Engagement**

- By using the principles of UDL when writing lesson plans, the goals, methods, materials, and assessments of content are the focus of learning, not student differences.

Viewer Activity: While watching the movie

While watching the movie, put a mark down if the following was addressed;

	Mimi "Crazy Lady" 
Goals of movie	
Parts of lesson plan	
Principles of UDL	
Examples of aerosol cans	
Non examples of aerosol cans	
Conceptions & misconceptions	
How aerosol cans work	
Shape of aerosol cans	
Questions of students	
3 UDL principles	
Assessment	
Materials	
Additional ideas	
Wants you to be a great teacher	

UDL Checklist

The left side is a checklist provided by www.CAST.org and the right side provides practical examples used in the lesson in the movie.

II. Provide multiple means of representation - Knowledge Networks	
1. Provide options for perception	
Customize the display of information	Size of writing/ volume on movie
Provide alternatives for auditory information	Script/ closed captioning
Provide alternatives for visual information	Text to speech software
2. Provide options for language and symbols	
Define vocabulary and symbols	Pre-teach vocabulary/ symbols (survey)
Clarify syntax and structure	Concept map of workings of can
Decode text and mathematical notation	Pictures for words/ text to speech
Promote cross-linguistic understanding	Scavenger hunt
Illustrate key concepts non-linguistically	Scavenger hunt/ movie
3. Provide options for comprehension	
Provide or activate background knowledge	Survey/ concept anchoring in movie
Highlight critical features, big ideas, and relationships	Objectives/ examples and non examples
Guide information processing	Chunking information/exploration of ideas
Support memory and transfer	Graphic organizer/ mnemonics
II. Provide multiple means for action and expression - Strategic Networks	
4. Provide options for physical actions	
Provide varied ways to respond	Survey on computer or write
Provide varied ways to interact with materials	Scavenger hunt
Integrate assistive technologies	Keyboard commands for mouse clicks
5. Provide options for expressive skills and fluency	
Allow choices of media for communication	Movie/text/speech/computer/experiments
Provide appropriate tools for composition & problem solving	Outlining tools/sentence starters/webbing
Provide ways to scaffold practice and performance	Guided questions in movie
6. Provide options for executive functions	
Guide effective goal setting	Models/examples
Support planning and strategy development	Informal assessment
Facilitate managing information and resources	Categorizing/ checklists/ guides
Enhance capacity for monitoring progress	Representation of progress charts/questioning

Continued on next page

III. Provide multiple means for engagement - Affective Networks	
7. Provide options for recruiting interest	
Increase individual choice and autonomy	Menu of choices
Enhance relevance, value, and authenticity	Encourage relevance of projects
Reduce threats and distractions	Can work by self/pairs/or groups
8. Provide options for sustaining effort and persistence	
Heighten salience of goals and objectives	Had to write a plan/ pick when due
Vary levels of challenge and support	Emphasis on process/standards
Foster collaboration and communication	Roles of group members
Increase mastery-oriented feedback	Questioning/interviews
9. Provide options for self-regulation	
Guide personal goal-setting and expectations	Prompts - verbal/nonverbal/written
Scaffold coping skills and strategies	Quiet corner of room/headphones
Develop self-assessment and reflection	Share learning/reflection

APPENDIX H:
VIEWER'S GUIDE EXPERIMENTAL GROUP

Aerosol Cans &
Universal Design for Learning (UDL)

- Instead of having an accommodation for a single student, that accommodation now becomes an option that all of the students in the class may utilize.

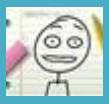
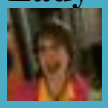
- By using the 3 principles of UDL in lesson plans, teachers have a plan for learning that accounts for abilities of all learners as well as promoting student awareness of different ways to learn.

	Provide Multiple Means of;
Principle I	**Representation**
Principle II	**Expression**
Principle III	**Engagement**

- By using the principles of UDL when writing lesson plans, the goals, methods, materials, and assessments of content are the focus of learning, not student differences.

Viewer Activity: While watching the movie

You will notice three main characters, each one representing a part of the teaching experience. While watching the movie, put a mark under the character who states each of the following;

	Da'Zhaun 	**Avatar** 	**Mimi "Crazy Lady"** 
Role in movie	*The reason for teaching – excitement for learning*	*The pedagogy*	*The content to be learned*
Learning styles			
2 Goals of movie			
Parts of lesson plan			
3 principles of UDL			
Where examples are			
Non examples of aerosol cans			
Conceptions & misconceptions			
How aerosol cans work			
Shape of aerosol cans			
Types of Questions			
Asks you for 3 UDL principles			
Talks about assessment			
Talks about materials			
Reviews movie			
Wants you to be a great teacher			

UDL Checklist

The left side is a checklist provided by www.CAST.org and the right side provides practical examples used in the lesson in the movie.

III. Provide multiple means of representation - Knowledge Networks	
1. Provide options for perception	
Customize the display of information	Size of writing/ volume on movie
Provide alternatives for auditory information	Script/ closed captioning
Provide alternatives for visual information	Text to speech software
2. Provide options for language and symbols	
Define vocabulary and symbols	Pre-teach vocabulary/ symbols (survey)
Clarify syntax and structure	Concept map of workings of can
Decode text and mathematical notation	Pictures for words/ text to speech
Promote cross-linguistic understanding	Scavenger hunt
Illustrate key concepts non-linguistically	Scavenger hunt/ movie
3. Provide options for comprehension	
Provide or activate background knowledge	Survey/ concept anchoring in movie
Highlight critical features, big ideas, and relationships	Objectives/ examples and non examples
Guide information processing	Chunking information/exploration of ideas
Support memory and transfer	Graphic organizer/ mnemonics
II. Provide multiple means for action and expression - Strategic Networks	
4. Provide options for physical actions	
Provide varied ways to respond	Survey on computer or write
Provide varied ways to interact with materials	Scavenger hunt
Integrate assistive technologies	Keyboard commands for mouse clicks
5. Provide options for expressive skills and fluency	
Allow choices of media for communication	Movie/text/speech/computer/experiments
Provide appropriate tools for composition & problem solving	Outlining tools/sentence starters/webbing
Provide ways to scaffold practice and performance	Guided questions in movie
6. Provide options for executive functions	
Guide effective goal setting	Models/examples
Support planning and strategy development	Informal assessment
Facilitate managing information and resources	Categorizing/ checklists/ guides
Enhance capacity for monitoring progress	Representation of progress charts/questioning

Continued on next page

III. Provide multiple means for engagement - Affective Networks	
7. Provide options for recruiting interest	
Increase individual choice and autonomy	Menu of choices
Enhance relevance, value, and authenticity	Encourage relevance of projects
Reduce threats and distractions	Can work by self/pairs/or groups
8. Provide options for sustaining effort and persistence	
Heighten salience of goals and objectives	Had to write a plan/ pick when due
Vary levels of challenge and support	Emphasis on process/standards
Foster collaboration and communication	Roles of group members
Increase mastery-oriented feedback	Questioning/interviews
9. Provide options for self-regulation	
Guide personal goal-setting and expectations	Prompts - verbal/nonverbal/written
Scaffold coping skills and strategies	Quiet corner of room/headphones
Develop self-assessment and reflection	Share learning/reflection

APPENDIX I:
VIDEO VALIDATION BY EXPERTS

Dr. Christopher O'Brian comments:

Great work! The quality of the video production is strong. Obviously, we lose quality in streaming video, but it looks very good overall. The little boy is wonderful as a narrator and it hits home that there are lots of kids out there are clearly bright and motivated when given the opportunity to succeed. I really loved the section where the student interacted with his mother to do the "hands on" experiment.

I liked how you made the "character" and "feel" of your video introduction consistent with the inserted science instructional video. It feels seemless. Also, the overlays of representation, expression, engagement are very helpful.

As far as representation of UDL goes, I think you did a nice job representing the overall concept of "representation, expression, engagement." I think I would want to see a little bit of classroom footage to see how students are grouped, how they interact with the teacher, what images are on the walls, how has peer support been established, etc. In particular, I would want to see how the teacher uses the video as a UDL strategy as opposed to "just another instructional video."

It's also hard to think of teaching as UDL without more explicit use of computer technology. For example, it would be great to see students in groups examining web-based materials or reading/listening to digital materials with TTS software. In essence, the next step beyond differentiated instruction.

Overall, I think you've done a wonderful job of capturing the "big picture" of UDL. A teacher would certainly understand the concept. I still thinking they would need more explicit training in their classroom--coaching model, but I'm sure you've thought of that already. One shot videos are never good enough.

I wish you good luck with this. Let me know if you have any questions.

APPENDIX J:
VALIDITY E-MAIL QUESTIONS

Hello everyone,

Thank you again for your help with my research.

I am now on the final part of the study and am asking for your help one last time. Please hit reply and answer the following three questions. The purpose of these questions is for validation from participants.

1. There were two versions of the aerosol can movie. Did you watch the one with a young boy and avatar narrating (this version also talked about UDL), or the version that only talked about aerosol cans?

2. Do you feel the movie you watched helped you learn more about universal design for learning (UDL)? Feel free to explain.

3. Overall, what did you think of the movie you watched?

Thank you all for your consideration in participating and feel free to contact me with any questions or concerns.

Sara Aronin
Saronin8@hotmail.com

PS. Just a reminder for FERPA, your answers will be kept confidential, however since you are responding by email I will be able to see your email address. Also, you must be at least 18 years old to participate.

APPENDIX K:
VIDEO RELEASE FORM FOR MAKING INTERVENTION VIDEO

Photograph/Video Release Form

Description of Material for Release:

Photographs and videos taken on the week of January 24 to 30, 2009 in the Teaching Academy, Education Complex or both at the University of Central Florida

Purpose of Release:

Photographs and video images will be used to create training presentations for teaching strategies and activities. The resulting video and images will be available to pre-service and in-service teachers, university staff as well as the CAST organization and Consumer Aerosol Products Council for use in professional development and course instruction.

Anonymity

No names or other identifying written information will be associated with the video images and photographs used in creating the video library. Additionally, no identifying class information will be associated with the resulting video library.

_____ I agree to release my rights for the use of the videos and photographs collected by Sara Aronin, Rebecca Hines, as well as the CAST organization and Consumer Aerosol Products Council for use in professional development and course instruction.

I understand that names or identifying information will not be associated in any way with the video images or photographs.

_____ I do **not** agree to release my rights for the use of videos and photographs.

_____ Participant Sign and Date

_____ Parent or Guardian Sign and Date

_____ Sara Aronin University of Central Florida

APPENDIX L:
VALIDITY TABLE FOR LESSON PLAN ANALYSES

Lesson Plan Categorizing

Thank you for agreeing to categorize the lesson plans for my study. You have received lesson plan sheets from my study that are numbered in random order. Please read them over carefully and place the number that corresponds with the survey in the column you feel it belongs. The two choices are the experimental group (video included universal design for learning) or control (video did not have universal design for learning).

Control Group	Experimental Group

APPENDIX M:
SCORING RUBRIC FOR UNDERSTANDING OF UDL FROM PRE POSTTEST

SCORING FOR UNDERSTANDING - QUALITATIVE QUESTIONS ON UDL

Universal Design for Learning (UDL) is an approach that addresses and redresses the primary barrier to making expert learners of all students: **inflexible, one-size-fits-all curricula** that raise unintentional barriers to learning. Learners with disabilities are most vulnerable to such barriers, but many students without disabilities also find that curricula are poorly designed to meet their learning needs.

Diversity is the norm, not the exception, wherever individuals are gathered, including schools. When curricula are designed to meet the needs of the broad middle—at the exclusion of those with different abilities, learning styles, backgrounds, and even preferences, they fail to provide all individuals with fair and equal opportunities to learn.

Universal Design for Learning helps meet the challenge of diversity by suggesting flexible instructional materials, techniques, and strategies that empower educators to meet these varied needs. A universally designed curriculum is designed from the outset to meet the needs of the greatest number of users, making costly, time-consuming, and after-the-fact changes to curriculum unnecessary.

From UDL Guidelines 1.0
Available from CAST

0	1	2	3
Blank	Cannot determine participants' meaning from stated answer	Partially developed Can determine that participant is on right track	Fully developed Can determine participant has a firm understanding of concept

Three primary principles guide UDL—and provide structure for these Guidelines:

- **Principle I: Provide Multiple Means of Representation** (the "what" of learning). Students differ in the ways that they perceive and comprehend information that is presented to them. For example, those with sensory disabilities (e.g., blindness or deafness); learning disabilities (e.g., dyslexia); language or cultural differences, and so forth may all require different ways of approaching content. Others may simply grasp information better through visual or auditory means rather than printed text. In reality, there is no one means of representation that will be optimal for all students; providing options in representation is essential.

- **Principle II: Provide Multiple Means of Expression** (the "how" of learning). Students differ in the ways that they can navigate a learning environment and express what they know. For example, individuals with significant motor disabilities (e.g. cerebral palsy), those who struggle with strategic and organizational abilities (executive function disorders, ADHD), those who have language barriers, and so forth approach learning tasks very differently and will demonstrate their mastery very differently. Some may be able to express themselves well in writing text but not oral speech, and vice versa. In reality, there is no one means of expression that will be optimal for all students; providing options for expression is essential.

- **Principle III: Provide Multiple Means of Engagement** (the "why" of learning). Students differ markedly in the ways in which they can be engaged or motivated to learn. Some students are highly engaged by spontaneity and novelty while other are disengaged, even frightened, by those aspects, preferring strict routine. In reality, there is no one means of representation that will be optimal for all students; providing multiple options for engagement is essential.

From UDL Guidelines 1.0
Available from CAST

APPENDIX N:
VALIDITY E-MAIL FOCUS GROUPS

Hello everyone,

Thank you again for your help with my research.

I am now on the final part of the study and am asking for volunteers to participate in a focus group relating to your opinions of the research.

The focus group will be on adobe connect (just like [redacted] classes) on May 21. There are two times to choose from – please feel free to pick whichever one works best for your schedule. The choices are either 1:00 pm or 9pm. The focus group will last about 20 minutes and you do not have to answer any question you do not feel comfortable with.

[redacted]

Thank you all for your consideration in participating and feel free to contact me with any questions or concerns.

Sara Aronin
Saronin8@hotmail.com

PS. Please remember all participation is voluntary and no compensation will be given and all participants must be above the age of 18.

APPENDIX O:
OPTIONAL PREWRITING ACTIVITY

OPTIONAL PREWRITNG ACTIVITY

1. Default Section

This is a prewriting strategy. There are three questions. Spend no more than 2 minutes per question for a total of 6 minutes. This should help you write you lesson plan. Make sure that you have watched the two minute reason for the seasons movie prior to doing the prewriting.

*

1. Please put in the last 4 digits of your PID and 3310 in the space below.

Add Question Here

2.

Provide Multiple Means of Representation is the first principle of universal design for learning (UDL).

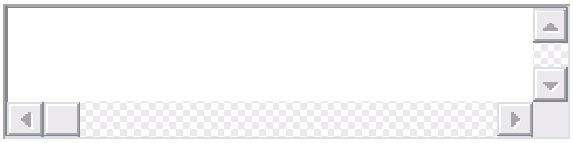
Add Question Here

Edit QuestionMoveCopyDelete

Based on this chart and knowing that you will be writing a lesson on reasons for the seasons, write a list of ways that multiple means of representation can be incorporated into your lesson plan. Remember, this is a quick write, so spend no more than 2 minutes.

I. Provide multiple means of representation– Knowledge Networks	
1. Provide options for perception	**Your Ideas**
• Customize the display of information	
• Provide alternatives for auditory information	
• Provide alternatives for visual information	
2. Provide options for language and symbols	**Your Ideas**
• Define vocabulary and symbols	
• Clarify syntax and structure	
• Decode text and mathematical notation	
• Promote cross-linguistic understanding	
• Illustrate key concepts non-linguistically	
3. Provide options for comprehension	**Your Ideas**
• Provide or activate background knowledge	
• Highlight critical features, big ideas, and relationships	
• Guide information processing	
• Support memory and transfer	

1. You are filling in your ideas - they do not have to be in sentences - just a quick list.



3.

Multiple Means for Action and Expression

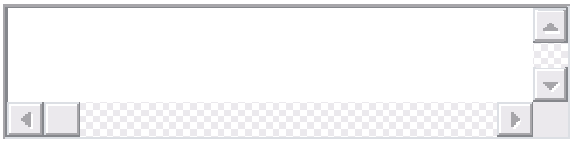
Add Question Here

Edit QuestionMoveCopyDelete

Based on this chart and knowing that you will be writing a lesson on reasons for the seasons, write a list of ways that multiple means of action and expression can be incorporated into your lesson plan. Remember, this is a quick write, so spend no more than 2 minutes.

II. Provide multiple means for action and expression - Strategic Networks	
4. Provide options for physical actions	**Your Ideas**
• Provide varied ways to respond	
• Provide varied ways to interact with materials	
• Integrate assistive technologies	
5. Provide options for expressive skills and fluency	**Your Ideas**
• Allow choices of media for communication	
• Provide appropriate tools for composition and problem solving	
• Provide ways to scaffold practice and performance	
6. Provide options for executive functions	**Your Ideas**
• Guide effective goal setting	
• Support planning and strategy development	
• Facilitate managing information and resources	
• Enhance capacity for monitoring progress	

1. You are filling in your ideas - they do not have to be in sentences - just a quick list.



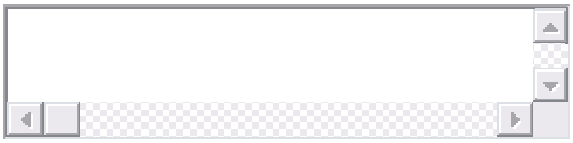
4.

Multiple Means of Engagement

Based on this chart and knowing that you will be writing a lesson on reasons for the seasons, write a list of ways that multiple means of action and expression can be incorporated into your lesson plan. Remember, this is a quick write, so spend no more than 2 minutes.

III. Provide multiple means for engagement - Affective Networks	
7. Provide options for recruiting interest	**Your Ideas**
• Increase individual choice and autonomy	
• Enhance relevance, value, and authenticity	
• Reduce threats and distractions	
8. Provide options for sustaining effort and persistence	**Your Ideas**
• Heighten salience of goals and objectives	
• Vary levels of challenge and support	
• Foster collaboration and communication	
• Increase mastery-oriented feedback	
9. Provide options for self-regulation	**Your Ideas**
• Guide personal goal-setting and expectations	
• Scaffold coping skills and strategies	
• Develop self-assessment and reflection	

1. You are filling in your ideas - they do not have to be in sentences - just a quick list.



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