STRATEGIES THAT TEACHERS IMPLEMENT TO HELP STUDENTS ACCESS THE GENERAL EDUCATION CURRICULUM: INVESTIGATING THE INSTRUCTIONAL STRATEGIES OF UNIVERSAL DESIGN FOR LEARNING

By

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ABSTRACT

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Teachers today are being asked to teach to a broad range of learners (D. Rose, Sethuraman, & Meo, 2000a; Schumm, Vaughn, Haager, McDowell, & et al., 1995) and traditional instruction in not adequate to address students' instructional needs (Coyne, Kameenui, & Carnine, 2007). Universal Design for Learning (UDL) has been suggested as a way to address those needs. This study investigated three independent variables, 1) teachers' level of UDL familiarity; 2) teacher assignment (i.e., general education, special education); and 3) years teaching to determine whether a difference existed between each independent variable and how K-12 public school teachers implement instructional strategies and technology that align with UDL, in their classrooms to help student's access the general education curriculum. This study employed survey and interview protocol to assess the instructional strategies and technology teachers implemented. Data from 14 special education and 42 general education teachers was analyzed using both MANOVAs and Crosstabulations.

This study suggests that while teachers implement many of the instructional strategies that align with and underlie UDL they do not do so with the intent of implementing UDL. Overall, teachers did not have a high level of knowledge about the theory of UDL. One MANOVA was significant and addressed differences between teacher familiarity with UDL and the implementation of instructional strategies for the component, *provide adjustable levels of* challenge. One Crosstabulation indicated that special education teachers implemented instructional strategies for the component *provide multiple opportunities to practice with supports* at a statistically higher level than general education teachers.

To my husband John who supported me throughout this journey and to my brother Bob without whom I would not have completed it.

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It is good to have an end to journey toward; but it is the journey that matters, in the end. - Ernest Hemingway

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CHAPTER 1

INTRODUCTION

"The biggest mistake of past centuries in teaching has been to treat all students as if they

were variants of the same individual and thus to feel justified in teaching them all the same

subjects the same way." – Howard Gardner

Students with diverse learning and curricular needs, primarily children of poverty, children identified with disabilities, and children with limited English-speaking skills face numerous forces – cultural, familial, sociological, political, and educational – that place them at increasing social and educational risk. For example, the cultural, familial, sociological, and political forces that influence the lives of children outside of school appear to affect in subtle but profound and insidious ways how children learn about their world and themselves when inside school.

At the beginning of the 21st century, the risk factors that plagued children with diverse learning and curricular needs a decade ago have not diminished. In fact, it could be argued that the risks that students with diverse learning and curricular need face are more intense now at the beginning of a new millennium than they were a decade ago (Coyne et al., 2007, p. 2).

Teachers today are being asked to teach a broad range of learners in their classrooms (D.

Rose et al., 2000a; Schumm et al., 1995). Traditional one size fits all instruction is not adequate

to address the increasing diversity of America's youth found in 21st century classrooms (Coyne

et al., 2007). In an era of accountability as exemplified by the No Child Left Behind (NCLB)

regulations, it is critical that teachers help all students succeed in the general education

classroom. In addition, NCLB 2002, IDEA 1997 and 2004 each require that every student,

including students with disabilities, must have access to the general education curriculum. Thus,

these policy mandates necessarily affect how schools design and modify the teaching and

learning contexts in which diverse learners receive the core curriculum.

Although many administrators and educators may feel ill prepared to address the special needs of struggling and at-risk learners (Rotter, 2004; Schumm et al., 1995; Snyder, 1999), Universal

Design for Learning (UDL) is an instructional model that has been proposed as a way to assist schools and teachers in designing curricula that help all students become more successful learners. UDL is a curricular framework that stresses proactive, intentional lesson planning to address the needs of the broad range of learners found in the classroom. There are three underlying principles that support the implementation of UDL, namely, multiple means of representation (e.g., presenting lessons using a variety of materials), multiple means of expression (e.g., allowing students to demonstrate learning in multiple ways), and multiple means of engagement (e.g., using multiple strategies to engage learners). At its essence UDL recognizes that students learn in multiple ways for multiple reasons and have multiple ways of demonstrating that learning, while also recognizing that most students will at some time encounter a barrier to learning.

In light of these recognitions, UDL calls for the educator to consciously develop the curriculum so that it addresses these various learning styles and supports students in overcoming potential barriers to learning. In this way the learning style alternatives (e.g., auditory, visual) and the necessary tools and strategies to overcome learning barriers are already in place prior to the teacher beginning his or her instruction. Thus, UDL offers a pedagogical framework that can assist educators to teach in a more efficacious manner not only to help their students gain access to the general education curriculum but, ultimately, to enhance their students' performance on local and national high-stakes assessments.

Universal Design for Learning is now specifically mentioned in both NCLB and IDEA as a means to help all students gain access to the curriculum in the general education classroom. Universal Education, adopted by the Michigan State Board of Education in 2005 (Michigan Department of Education, 2006), focuses on meeting the learning needs of all students and

ensuring that those needs are addressed throughout their lifetime. UDL is seen as a vehicle that could support the implementation of Universal Education in the classroom (Eckhardt, 2008). This may mean that teachers in the state of Michigan may now be asked to learn about Universal Design for Learning as a way to help all students succeed in the state's broader Universal Education concept (Eckhardt, 2008).

Classroom teachers currently feel overwhelmed by all of the demands that are placed on them (Landsman, Moore, & Simmons, 2008). They face time constraints, allocation of limited resources, testing pressures, curriculum demands, and other matters that require their attention. So, even if teachers have the desire to change their instructional practices, these matters (e.g., time constraints, limited resources) may form additional barriers they need to overcome to realize that desire (Knight, 2009). To some, requiring the implementation of an additional program may seem overly burdensome or even unachievable. Nevertheless, UDL is being considered as an instructional framework that would support the delivery of Universal Education in the state of Michigan (Eckhardt, 2008).

The purpose of this research study is to survey teachers to determine which of the instructional strategies that align with the UDL principles are already being used in their classrooms, as well as to evaluate teachers' knowledge of the UDL framework. The survey results could inform teachers that they are already implementing many of the UDL strategies in their classrooms. If so, the findings of this survey could help ameliorate the frustration of teachers who, if asked to implement UDL, believe they are being asked to add yet another instructional component to their already overburdened schedules (Margolis & Nagel, 2006). In addition, this research could provide valuable information to teacher educators, administrators, professional development providers, and researchers. Each of these groups could examine this

research to determine areas where instruction regarding the UDL framework is needed. Researchers could implement this survey in their local areas to determine where strong implementation of UDL components is linked to a high level of self-declared UDL knowledge. Then they could begin to conduct research in those areas regarding the implementation of the UDL framework.

Research Questions

This study seeks to answer the following questions about teacher implementation of instructional strategies that align with the Universal Design for Learning framework. It further addresses the use of technology in the classroom as it is applied to the implementation of the instructional strategies that align with the UDL principles and framework.

- 1. What is the type and frequency of teacher self-declared implementation of instructional strategies that align with the UDL principles?
- 2. What is the teacher's self-declared knowledge of the UDL principles and what is the difference, if any, between that level of self-declared knowledge and the level (considering both type and frequency) of the self-declared implementation of instructional strategies that align with UDL principles?
- 3. What is the type and frequency of teacher self-declared use of technology for the implementation or completion of instructional strategies that align with the UDL principles?

CHAPTER 2

LITERATURE REVIEW

Teacher Implementation of Universal Design for Learning

In order to understand how the use of the Universal Design for Learning (UDL) framework improves instruction it is important to look at several strands of theoretical and empirical literature. First to be explored will be the sociocultural aspect of learning, which offers a pedagogical model to explain the nature of teaching and learning in a manner that is consistent with UDL principles. Second, the features of the UDL framework will be examined to determine the ways in which it can be implemented to create a more positive learning environment for all students. Of course, whether the UDL framework creates a more positive learning environment means little unless teachers are willing to implement that framework. Thus, changing teachers' beliefs are next considered, together with how changing those beliefs translates into changes in instructional practices. Fourth, the literature that addresses UDL research will be discussed. Finally, an examination of how technology can support UDL instructional practices will be undertaken. This chapter will conclude with an explanation of the purpose of this study.

Learning as a Sociocultural Process

Instructional curricula and pedagogy are designed based on pedagogical models of teaching and learning. A pedagogical model is fundamental to effective curriculum design and delivery because it determines *what* is taught in schools, *how* it is taught, *when* it is taught, and *why* it is taught. A pedagogical model that frequently guides classroom instruction takes the view of the teacher as the dispenser of knowledge. In this traditional model of instruction, often referred to as transmissive instruction (Jonassen & Land, 2000), learning takes place when knowledge is transmitted from the teacher to the learner. In the transmission model, learning is

believed to be improved by communicating ideas more effectively to the learner (Wertsch, 1991). This is accomplished by improving the clarity of the teacher's message. The assumption is that if teachers effectively communicate (transmit) what they know, students will understand the material as well as the transmitter does. Therefore, teaching is viewed as a process of conveying ideas to students, and good teaching results from (and is synonymous with) more effective communication (Jonassen & Land, 2000). In this model, knowledge is viewed as an object to be conveyed between individuals (Wertsch, 1991), and learning is believed to take place when students remember and employ the facts, principles, or rules presented by the teacher (Jonassen & Land, 2000; Nieto, 1992, p. 66).

In contrast to the transmission model, the Universal Design for Learning (UDL) model views the role of the teacher as being one of guiding and supporting students' learning through the active construction of meaning, rather than through the imparting of knowledge (Meo, 2008). The UDL framework is informed by sociocultural theory. Sociocultural theorists (Lave & Wenger, 2003; Vygotsky, 1978; Wertsch, 1991) espouse learning as a social activity in which knowledge is constructed and developed through interactions with others rather than through the solitary and private activities of individuals acting alone (John-Steiner & Mahn, 1996; Lave & Wenger, 2003; Rogoff, 2003; Smith & Wilson, 2001; Vygotsky, 1978; Wertsch, 1991). They argue that *meaningful learning* takes place through knowledge building within a community of social practice (John-Steiner & Mahn, 1996; Lave & Wenger, 2003; Rogoff, 2003; Smith & Wilson, 2001; Vygotsky, 1978; Wertsch, 1991), rather than through knowledge transmission from the "teacher" to the "student" (Curry, 2003; Jonassen & Land, 2000; Kumpulainen & Wray, 2002; Meo, 2008; Vygotsky, 1978; Wertsch, 1991).

This section of the paper first examines the theory of learning as a sociocultural process and then considers the components of this theory. In that consideration, it explores the related concepts of creating environments where: 1) the student's learning is determined by zones of proximal development (ZPD) (Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991); 2) learning is supported by knowledgeable others (Borthick, Jones, & Wakai, 2003; IES National Center for Education Research, 2007; Radziszewska & Rogoff, 1988; Rogoff, 1990; Vygotsky, 1978); and 3) scaffolds are used to ensure academic success (Doering & Veletsianos, 2007; Englert, Berry, & Dunsmore, 2001; Mooney, 2000; Ormond, 2006; Vygotsky, 1978).

Sociocultural Theory

Sociocultural learning is based on the theory that culture and language contribute to human development (John-Steiner & Mahn, 1996; Kumpulainen & Wray, 2002; Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991). Proponents of sociocultural theory believe that virtually all learning is embedded in a cultural context that includes cultural tools and is part of a range of social activities (Curry, 2003; Rogoff, 2003; Salomon & Perkins, 1998; Vygotsky, 1978; Wertsch, 1988, 1991). Furthermore, sociocultural learning shifts the assumption that competence resides within an individual, taking the perspective that the role of social context accounts for the development of a student's competence (Rueda, Gallego, & Moll, 2000; Vygotsky, 1978). Vygotsky (1978), the foremost architect of this model, believed that adults foster a child's cognitive development in an intentional and systematic manner. This is accomplished by engaging children in meaningful and challenging activities in a context that is rich with formal and informal discourse about the activity (Ormond, 2006; Palinscar & Brown, 1984; Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991). Rather than interacting with students at an informational level, such as that seen in transmissive instruction, the sociocultural teachers interacts at a meta-cognitive level where the dialogue encourages the learner to think through a problem rather than positioning the learner to receive the teacher's answer (Grabinger, Aplin, & Ponnappa-Brenner, 2007).

A primary means by which students learn is through participation in mediated interactions with adults or more knowledgeable others as they jointly perform cognitive activities (Palinscar & Brown, 1984; Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991). In this context, adults at first lead students' cognitive performance by modeling and thinking-aloud as they perform the steps of the cognitive activity (Horner, Bhattacharyya, & O'Connor, 2008; Palinscar & Brown, 1984; Steele, 2001). Gradually, the adult shifts increasing responsibility for the talk and cognitive activity to the students while the adult remains ready to support students' performance when they struggle (Palinscar & Brown, 1984). Kumpulainen & Wray (2002) state that this perspective emphasizes both the social and situated nature of knowledge construction. The sociocultural approach to learning suggests that learning is not a passive activity, but it entails a social interaction (i.e., discourse) in which learners participate in mediated activities with others in order to construct new knowledge (Nieto, 1992; Ormond, 2006; Palinscar & Brown, 1984; Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991).

Components of the Sociocultural Theory

There are many components of the sociocultural theory that can be applied by teachers to help students become more successful learners in the classroom. Importantly, these components emphasize the value of instructional supports that teachers can design to help their students learn content and cognitive routines that may otherwise be too difficult for them to understand or perform on their own. Students fall along a continuum on which at a given point in time, each may need varying amounts of support to perform particular aspects of a given cognitive activity.

In addition, over time the amount of additional support required by a given student will vary and may even no longer be needed (as, for example, when the student comes to serve as the more knowledgeable other who helps peers in need of assistance). Along this continuum lies what Vygotsky (1978) refers to as the zone of proximal development (ZPD).

The ZPD is the gap between the level of performance achieved by a student working alone, and the level of performance achieved by the student working in collaboration with more knowledgeable others or with the mediational support afforded him/her through the provision of well-designed instructional scaffolds (Harris & Pressley, 1991; Palinscar & Brown, 1984; Rogoff, 2003; Vygotsky, 1978; Wertsch, 1988, 1991). The ZPD lies just ahead of a student's current performance levels, and is the region of instructional sensitivity where the most significant learning occurs (Ormond, 2006; Tomlinson et al., 2003; Vygotsky, 1978; Wertsch, 1988, 1991). With the provision of proper scaffolds, strategies, or social supports, the ZPD is an instructional space where teachers can offer a type of instructional bootstrapping (i.e., support) that will allow students to advance to new understandings and performance levels that otherwise would be unattainable in a less supported environment (Borthick et al., 2003; Englert, Manalo, & Zhao, 2004; Vygotsky, 1978).

Intersection of UDL and Sociocultural Learning

As noted earlier, sociocultural learning offers a pedagogical model to explain the nature of teaching and learning in a manner that is consistent with the UDL framework and principles. Sociocultural learning creates a paradigm shift in which the development of student competence is fostered by the role of social context (i.e., the learning situation) rather than being a static condition that resides within an individual (Rueda et al., 2000; Vygotsky, 1978; Wertsch, 1988, 1991). This concept corresponds with the UDL tenet which stresses that the barriers inherent in

the curricular context prevent some students from accessing it fully, rather than believing that the learning difficulties reside within the student (e.g., materials presented only in written form create barriers to learning for students who struggle with reading).

Essentially, when teachers create lesson plans that intentionally remove barriers in the curricular context, the learning situation is altered to provide a means for more students to fully access the general education curriculum. For example, providing text-to-speech options for electronic assessments allows students who struggle with reading to access the material and demonstrate knowledge of the curricular content. This intentional instructional planning fosters a child's cognitive development consistent with the sociocultural model's view that adults foster a child's cognitive development in an intentional and systematic manner (Rogoff, 1990; Vygotsky, 1978; Wertsch, 1988, 1991). By intentionally overcoming curricular barriers, teachers make conscious choices about the delivery of instruction and the necessary activities to help students achieve the goals of the lesson. To be most effective, these choices, according to both sociocultural and UDL theories, must provide students with meaningful activities to support access and learning while still maintaining the learning challenge for the student (King-Sears, 1997; D. Rose et al., 2000a; Rueda et al., 2000; Vygotsky, 1978).

The zone of proximal development is another sociocultural pedagogical principle that is deeply embedded in the Universal Design for Learning framework (D. H. Rose, Meyer, & Hitchcock, 2005; D. H. Rose, Meyer, Strangman, & Rappolt, 2002). UDL incorporates this principle through the employment of various sociocultural supports (e.g., modeling, scaffolds, prompts, mediated learning) and strategic tools with the understanding that students must be challenged and supported to an appropriate degree in order to reach both optimum learning and engagement levels (Meece, 2003; Orkwis, 1999; Palinscar & Brown, 1984; Rogoff, 2003; D. H.

Rose et al., 2002; Tomlinson et al., 2003; Vygotsky, 1978; Wertsch, 1988, 1991). In addition, UDL proponents argue that scaffolds that support students' performance (e.g., providing the support of a more knowledgeable other, or supplying prompts) can be provided not only through teacher instruction, or working together with peers, but also through the provision of technology (Curry, 2003; Englert et al., 2004; Englert, Zhao, Dunsmore, Collings, & Wolbers, 2007). For example, digital media can be used as a means for mediating performance, enabling students to gain access to information (Okolo, 2006), and to attain more advanced performance levels (Englert et al., 2007; D. H. Rose et al., 2005). With thoughtful design, technologies can be calibrated to advance student's individual performances by offering the precise type of support that is needed by a particular student on any given cognitive task at any given moment. In many cases, a student can be allowed to elect to use or not use particular scaffolds, which is a way to add or remove supports in a timely and efficacious manner that is best suited to the learning preferences of that student. See Table 1 for definitions and examples of sociocultural supports.

Table 1	
Sociocultural	Supports

Terms:	Definitions:	Examples:
Scaffolding	Occurs when a more knowledgeable other provides explicit guidance or structure in order for students to perform a task in their zone of proximal development (Burke et al., 1998; Gersten & Clarke, 2007; Grossen et al., 2002; Vygotsky, 1978).	Graphic organizers, templates, and prompts
Modeling	A metacognitive process that allows the student to hear their teacher's thought process about a pattern or concept because the teacher demonstrates the task while simultaneously thinking aloud the process (Burke et al., 1998; Grossen et al., 2002; Harris & Pressley, 1991; Ormond, 2006; Vygotsky, 1978).	Teachers verbalize the procedure for long division by thinking aloud as they demonstrate a long division problem for students.

Table 1 (cont'd)

Zone of

(ZPD)

Proximal

Development

The gap between the level of performance achieved by a student working alone, and the level of performance achieved by the student working in collaboration with more knowledgeable others or with the mediational support afforded him/her through the provision of well-designed instructional scaffolds. The ZPD is the area where the most significant learning occurs (Harris & Pressley, 1991; Vygotsky, 1978) Teachers work in small groups with students to help them complete the steps of mathematic procedures that they are unable to do on their own.

or Teachers support student's who struggle with writing a biographical book report by providing them with a book report form to respond to. Once they answer the individual prompts (questions) they take their written responses and put them into a report format.

Universal Design for Learning

Teachers face national demands to make sure that all students succeed by employing instructional practices and tools that address diverse learning styles, abilities, backgrounds, and interests (Meece, 2003; Rose2000; Schumm et al., 1995). This section of the paper focuses on how the philosophy of UDL applies to the classroom and instructional environment and provides an explanation of the principles of UDL. This section also considers the various tools and strategies that could make UDL effective for all learners. Lastly, his section, examines change in teacher's beliefs and how that change leads to the adoption of a new innovation.

The Development of UDL

Universal design. The concept of Universal Design started in the field of architecture. Universal Design is described as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (The Center for Universal Design: Environments and Products for All People, 2005). Curb cuts are often used to explain the concept of Universal Design. Curb cuts were initially created for use by people with disabilities, but curb cuts proved to be useful for all people. Bike riders, skateboarders and people pushing strollers all benefit from the use of curb cuts. Thus, an architectural design that improved access for one group of individuals proved useful for other users. Stairs are an example of a barrier to mobility for individuals both entering into and navigating through buildings (D. H. Rose, 2000). When the Americans with Disabilities Act (ADA) passed in 1990, public buildings in the United States began to change. ADA mandates required retrofitting public buildings for accessibility. In order to accommodate individuals with disabilities, accessibility ramps, elevators and wider doorways were added to most public buildings. Many times these retrofits proved costly, problematic, and unattractive (Hitchcock, Meyer, Rose, & Jackson, 2002; Pisha, 2003). Soon people realized that designing new buildings with accessibility features to accommodate everyone from the onset was better, easier, and more cost effective than making later modifications to the building (Hitchcock, 2001; U.S. Department of Education Office of Special Education Programs, 2003). Universally designed environments were able to seamlessly incorporate adaptable and accessible features into the physical environment that suited many users beyond the target group (Meyer & Rose, 2000).

Universal Design for Learning. Based on universal principles that guided architectural design, educators at the Center for Assistive Special Technologies (CAST) and others began to apply those principles to the design of educational environments (Blamires, 1999; Bremer, Clapper, Hitchcock, Hall, & Kachgal, 2002; Hitchcock et al., 2002; Orkwis & McLane, 1998; D. Rose et al., 2000a). "In the early 90's educators at CAST [Center for Applied Special Technology] began to recognize that learning materials such as books were analogous to stairs" (D. H. Rose, 2000). Much like the architects, these educators and researchers realized that by

providing flexible instruction and curriculum they could create significant advantages for all learners (Hitchcock, 2001; D. H. Rose, 2000). UDL incorporated the principles of universal design in an instructional paradigm that offers new ideas about teaching, learning and designing curriculum. In this paradigm shift, Rose, Sethuraman, and Meo, (2000a) state that philosophies about teaching and learning are changed in four essential ways: (a) Educators begin to view students with disabilities as occupying a position along a continuum of learners rather than being a distinct and separate group; (b) adjustments for learner differences are applied to all students not just those with disabilities; (c) curriculum materials become more varied, diverse, and expansive by including a variety of resources, both digital and online, instead of just a single text; and (d) educators transform their instructional goal from a focus on fixing students so that the student can fit into and manage the traditional curriculum, into an instructional goal that focuses on fixing the curriculum so that it adjusts to fit the varying learning needs of the student (King-Sears, 1997).

Creating a UDL curriculum means creating materials to minimize student barriers and maximize student access to both learning opportunities and curriculum (U.S. Department of Education Office of Special Education Programs, 2003). One of the major advantages is that student access is built into the foundation of the curriculum by eliminating barriers that impede performance and entry into the traditional curriculum (e.g., providing alternatives to written text such as Braille for students with visual impairments), which in turn can eliminate the need for further accommodations. Another advantage is that students no longer have to wait for undetermined amounts of time while materials are accommodated to suit their specific needs (Allan & Slatin, 2005; Wehmeyer, Smith, & Davies, 2005). By using components of sociocultural learning such as scaffolds (e.g., graphic organizers, templates, and prompts) and

allowing students to work with knowledgeable others (e.g., peer tutors, small groups, and mentors) (Wiebe Berry, 2006) teachers can meet the needs of their students and provide access to the curriculum at the onset of instruction and thus reduce the need for making accommodations or modifications later on.

In order to understand the rationale behind UDL it is imperative to consider it in a meaningful way. On the surface the term "universal" appears to denote a one-size-fits all curriculum. However, just the opposite is true. The relevant term is not "universal" but rather "universal design", which as noted previously describes products and environments "… usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." (The Center for Universal Design: Environments and Products for all People, 2005). Thus, a UDL curriculum is one that is designed to be sufficiently flexible to meet the specific needs of every student, rather than requiring either the student to adjust him or herself to fit the limitations of the curriculum or the teacher to make an ad hoc adjustment to the curriculum so that it can accommodate the needs of the student.

In summary, UDL emphasizes the need for inherently flexible and adaptable content, assignments, and activities (Bremer et al., 2002; Cawley, Foley, & Miller, 2003; M. Izzo & Murray, 2003; Orkwis, 1999, 2003; D. H. Rose, 2000). This inherent flexibility reduces barriers in the curriculum by providing multiple approaches to access the content (e.g., video, websites, text) thereby significantly reducing the need for teachers to provide adaptations or modifications to students after the initial instruction has taken place. Additionally, providing multiple approaches to access the content also helps teachers maximize the equality of instruction for students (Hitchcock et al., 2002) by addressing the diverse learning needs of the students. Ultimately, UDL is not only better for student learning but is also better for teachers as it frees

them from much of the need to make ad hoc accommodations/modifications, thus generating increased time for observing the needs of, and meaningfully interacting with, all of their students.

The UDL Framework

There are three overarching principles that combine to create the UDL framework, namely, that the learning environment, and ultimately learning, is improved when the instructional context intentionally offers: (a) multiple means of representation (i.e., presenting educational materials using multiple instructional methods); (b) multiple means of action and expression (i.e., providing alternative formats for students to demonstrate what they have learned); and (c) multiple means of engagement (i.e., using student's interests and abilities to inform instruction and increase motivation). These three principles help to minimize barriers and maximize learning by mandating a flexible approach to teaching which supports the learning differences of individual students (Meyer & Rose, 2000; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). Because UDL assumes that every learner has individual strengths, individual weaknesses, and individual interests, these learning differences are addressed from the onset of instruction. This approach accomplishes two important objectives; obstacles to the general education curricula are greatly decreased while at the same time learning opportunities are enhanced for all students (Meece, 2003; D. H. Rose, 2000; D. H. Rose et al., 2002; Schumm et al., 1995). (The instructional components of the UDL framework are discussed in further detail later in the paper.)

UDL Assumptions

Before addressing the three fundamental principles of UDL, it is necessary to understand that two essential assumptions are embedded in the UDL framework and principles. The first

assumption is the need for concise and flexible teaching goals that meet the need of all students. The second assumption is the need to design instruction that provides access to *learning* the curriculum.

Prior to addressing the principles of UDL, teachers must establish clear and concise learning goals for all students (Meece, 2003; Meo, 2008). UDL emphasizes that all students should have appropriate goals based on their skills, interests, abilities, expertise, and rates of progress (D. Rose et al., 2000a). An inflexible goal (e.g., all students will use a standard algorithm to subtract two 3-digit number with regrouping) will never be an adequate UDL goal because it cannot challenge each student to learn as it does not afford multiple options for presentation and performance (Hitchcock et al., 2002). An inflexible goal, such as the example above, asks students to demonstrate their learning solely in one way, and only recognizes that one way of attaining the instructional goal. The inflexibility in this example is emphasized by the concept of using a "standard algorithm with regrouping" to demonstrate learning. It does not challenge each student to learn because it does not recognize that there are many ways of achieving and demonstrating the instructional goal. In contrast, however, a teacher who has established a flexible goal (e.g., students will use standard algorithms, alternative algorithms, or manipulatives to subtract two 3 digit numbers with regrouping) can develop various means to provide flexible instruction and support to help each student reach the goal (subtraction and regrouping accuracy) without undermining the challenge of learning (Hitchcock et al., 2002; Meyer & Rose, 2000; Orkwis, 1999, 2003; D. H. Rose, 2000).

Additionally, UDL has been proposed as a method to provide access to *learning* the curriculum. A curriculum is a plan for instruction that is adopted by a school system. Its purpose is to guide instruction, activities, content, methods, and outcomes. This is achieved through the

use of student materials, teacher's guides, assessments, and other supplementary materials (Hitchcock et al., 2002; D. H. Rose, 2000). With IDEA 2004 and the NCLB initiative, it is critical that teachers ensure all students have access to and progress in the general education curriculum. That is, all students must be afforded the ability to access and learn the curricular content, and they must be able to demonstrate their knowledge and mastery by achieving the requisite performance standards.

In this light, it is imperative that teachers understand the critical instructional difference between universal design for access to the curriculum and universal design for access to *learning* the curriculum (D. H. Rose, 2000). Universal design for access to the curriculum provides the greatest amount of support possible for a student, but that support can also reduce the challenge in the level of that work. Ultimately, the reduction or elimination of the cognitive challenge of the material can undermine student learning because challenge and complexity are essential to the development of higher-order thinking, problem-solving, deep understanding, and critical reasoning abilities (National Research Council, 1999; Orkwis, 1999; Orkwis & McLane, 1998; D. H. Rose et al., 2002; Vygotsky, 1978; Wertsch, 1988, 1991). In contrast, designing instruction that consciously addresses universal design for access to *learning* the curriculum provides only enough support to create a level of challenge that optimizes the learning opportunity for students (D. H. Rose, 2000). Universal design for access to *learning* is comparable to Vygotsky's (1978) zone of proximal development where appropriate support in the performance of the targeted behavior allows students to achieve at their optimum learning level.

For instance, if the goal of a teacher is to help a student learn to decode text, then using a text-to-speech (TTS) device would undermine that goal rather than support it (i.e., it eliminates the challenge by doing the decoding work for the student), thus creating the universal access to

curriculum conundrum. In this case, the provision of a TTS device removes the performance aspects of the task that are essential to student's content mastery and literacy development. On the other hand, if the instructional goal is to master the content of a text, then using a text-tospeech device would be an appropriate level of support because it would allow the student to access the content of the written material so that it could be learned and applied to the appropriate task (i.e., universal design to access *learning* the curriculum).

Three Principles of UDL

Once teachers understand the importance of creating flexible goals and the need to implement universal design to access *learning* the curriculum, they are ready to design curricular activities that incorporate the three instructional principles of UDL, namely: (a) multiple means of representation; (b) multiple means of action and expression; and (c) multiple means of engagement. Additionally, there are instructional methods (i.e., strategies) germane to each principle that ensure that learning is not only efficacious, but addresses the diversity of the students in today's classrooms (Meece, 2003; D. H. Rose, 2000; Schumm et al., 1995). To examine the UDL Principles and their components see Table 2.

Table 2UDL Principles 1, 2, 3 and Components

UDL Principles	UDL Components
Principle 1. Multiple means of representation	
Therpie 1. Wattiple means of representation	Provide multiple examples
	Stress/Highlight critical features
	Supply multiple media and formats
	Support background knowledge
Principle 2: Multiple means of action and	
expression	Supply flexible models of skilled performance
	Provide multiple opportunities to practice with supports
	Provide ongoing, relevant feedback

Table 2 (cont'd)

Offer flexible opportunities for demonstrating skills

Principle 3: Multiple means of engagement

Offer choices of content and tools
Provide adjustable levels of challenge
Purpose choices of rewards
Offer choices of learning context

Principle 1. The first principle of UDL, *multiple means of representation*, addresses the view that students learn through the ability to recognize and understand patterns, information, and concepts (Bartlett, Goodman Turkanis, & Rogoff, 2001; Meyer & Rose, 2000; D. Rose, 2000). An example of this is when students try to identify and learn letters, words, or more complex patterns such as following the steps in a sequence (D. H. Rose et al., 2002). Instructional strategies to achieve this goal fall into one of four components.

1. *Provide multiple examples*. It is through multiple examples that students begin to extract and thus learn the critical features which define and distinguish one pattern or concept from another (Friend & Bursuck, 2009; Meyer & Rose, 2000; D. H. Rose, 2000; U. S. Department of Education Office of Special Education Programs, [USDOE, OSEP], 2003). For example, in order to help a student understand the concept of a triangle, it would be important for him or her to see triangles of many sizes and types. It would be imperative for the student to see equilateral triangles, scalene triangles, and isosceles triangles, in order to understand that all sides of a triangle do not have to be equal. All of these examples would help the student build the pattern recognition for the concept "triangle." However, equally important in the pattern-building process is the idea of providing non-examples (Merrill, 2002; D. H. Rose et al., 2002), such as those represented by 4-sided shapes (e.g., rectangles, squares, and parallelograms), so that students can further define the concept or pattern of a triangle. By providing multiple examples

and non-examples, teachers support students in their development of patterns and concepts (Meyer & Rose, 2000; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003).

2. Stress/highlight critical features (Deshler et al., 2001; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). A second component that can be employed to enhance student acquisition of a new concept is stressing or highlighting the critical features of that concept (Deshler et al., 2001). Building pattern recognition is difficult work for students even when they are exposed to multiple examples (Deshler et al., 2001; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). Educators can scaffold pattern recognition by highlighting the critical features of the patterns being taught (Friend & Bursuck, 2009; D. H. Rose et al., 2002). Scaffolding occurs when a more knowledgeable other provides explicit guidance or structure in order for students to perform a task in their zone of proximal development (Burke, Hagan, & Grossen, 1998; Gersten & Clarke, 2007; Grossen et al., 2002; Vygotsky, 1978). This can be accomplished by having teachers model and highlight the critical features of the pattern or concept they are teaching. Continuing with the example of the triangle, a teacher would talk about what makes a shape a triangle by naming the critical and common features shared by all members of the triangle family. This metacognitive process (i.e., modeling) allows the students to hear their teacher's thought process about the pattern or concept of a triangle and it allows the teacher to stress the critical features of a triangle (Burke et al., 1998; Grossen et al., 2002; Harris & Pressley, 1991; Ormond, 2006).

3. *Supply multiple media and formats* (Gersten, Baker, Smith-Johnson, Dimino, & Peterson, 2006; Okolo, 2006; D. H. Rose et al., 2002). A third component of the multiple means of representation principle is premised on the concept that there are diverse learners in the

classroom and that this diversity extends to how each learner processes sensory information (i.e., tactile, visual, aural, olfactory) (Gersten et al., 2006; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). In order to reach all of those diverse learners, teachers must scaffold student learning by using multiple media and formats (Gersten & Clarke, 2007; Okolo, 2006).

While the prior example involving the modeling of triangles would be a very good support for some students, it would not provide the type of scaffolding needed by others. In addition to verbal modeling (Allor, Gansle, & Denny, 2006; Horner et al., 2008) a teacher could also use visual representation (e.g., drawings, manipulatives) (Gersten & Clarke, 2007) to present the concept of triangles during the discussion so that students could see the triangles as she talks about them. Still other students may need to hold the triangles and feel the sides and the angles as these critical features are discussed. The opportunity to experience multiple representations of a concept, including models such as visual representations and manipulatives, is particularly crucial to help students with special needs transfer their existing knowledge and develop a context for their learning (Gersten & Clarke, 2007). The important point is that all students are provided multiple representations in a variety of media and formats which they can use to the extent they deem necessary to support their unique learning. Thus, multimodal teaching not only improves learning for struggling students but also benefits the learning for all children in the classroom because it supports each student's unique learning needs (Gersten et al., 2006; D. H. Rose et al., 2002).

4. *Support background knowledge* (Siegel, 1995). The fourth component relates to connecting new concepts to background knowledge. When students learn something new they need to incorporate it into what they already know (Burke et al., 1998; Carnine, Jitendra, &

Silbert, 1997; D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). Teachers can help students make connections by being explicit about the relationship between new knowledge and prior knowledge (Allor et al., 2006; Carnine et al., 1997; Deshler et al., 2001; Lenz, 2006). When new knowledge is explicitly related to old knowledge, a student with special needs can generally make the connection (Allor et al., 2006; Carnine et al., 1997). Rose et al. (2002) recognize that many teachers practice these techniques in the classroom but they stress that the use of digital content and flexible learning tools enhance the ability to make connections that support all learners in the classroom more effectively. For example, the use of scanning software helps students access text in a digital format (Fasting & Lyster, 2005; Higgins, 2005) and can help them make connections between background knowledge and new content. In addition, the use of video clips can also help students avoid text barriers (Okolo & Ferretti, 1996), make knowledge more explicit, and bridge the connection from background knowledge to new knowledge (Okolo, 2006).

Principle 2. The second principle of UDL, *multiple means of action and expression*, focuses on the student's ability to plan, execute, and self-monitor skills and actions (D. H. Rose et al., 2002). To support student diversity teachers should provide students with multiple means of action, expression and apprenticeship (Organisation for Economic Co-Operation and Development (OECD), 2007; Posner & Rothbart, 2004; 2005; D. H. Rose et al., 2002). Instructional strategies to assist educators in achieving this goal fall into one of the following four components.

1. *Supply flexible models of skilled performance* (D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). Learning how to perform a new task, or how to replicate a procedural pattern, requires developing an accurate mental model of the

problem-solving heuristic or strategic pattern (D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). The best way to develop that mental model is by exposure to external models in the form of both expert examples that make visible the steps of the task (Burke et al., 1998; Merrill, 2002), and counter-examples which demonstrate incorrect execution of a task (Merrill, 2002; D. H. Rose et al., 2002). This exposure can be accomplished in a variety of ways. For example, teachers can expose students to a new mental model by varying the presentation mode (e.g., thinking-aloud as they perform the actions associated with each step in a new task or routine), the media (e.g., video, text, animation), or the learning context (e.g., in whole class, small group, and/or one-on-one demonstrations) during instruction. Through varying these instructional strategies (i.e., presentation mode, media, and learning context) teachers provide optimum learning opportunities that address the diverse learning needs of students in the classrooms (Curry, 2003; Englert et al., 2007; Gersten et al., 2006; Gersten & Clarke, 2007; Horner et al., 2008; Keel, Dangle, & Owens, 1999; Okolo, 2006; Palinscar & Brown, 1984; Pisha, 2003; Vaughn, Gersten, & Chard, 2000).

By using multiple models which display effective methods to achieve a goal, learners start to determine the critical features of, and the procedural steps necessary to perform, a process (Burke et al., 1998). This in turn allows students to find opportunities to implement their own unique approach to achieving that goal (D. H. Rose et al., 2002). Furthermore, when a teacher allows students to discuss ideas and find alternative routes to achieving the same goal, an opportunity is created for students to participate in the social construction of knowledge (D. H. Rose et al., 2002). More specifically, when a teacher helps the child to think aloud about what he or she is learning, to recognize the underlying principles, and to apply those principles in their preferred learning style for achieving that goal, it not only helps that student but also makes it

possible for other students to borrow or appropriate those ideas and methods to apply to their own learning activities (Ormond, 2006).

2. Provide multiple opportunities to practice with supports (Larkin, 2001; Ormond, 2006; D. H. Rose et al., 2002). Complex strategic goals are achieved when the procedural steps to accomplish a particular goal are automatized or over-learned (D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). This requires practice and rehearsal because it is difficult to learn all of the steps to a complex skill in context. Sometimes teachers try to assist students by asking students to practice the steps in isolation, rather than in context, even though this is not as effective (D. H. Rose et al., 2002). An alternative to practicing steps in isolation is to scaffold the learner during a complex process (Burke et al., 1998; Larkin, 2001). Through scaffolding teachers can focus students' attention on the entire process while supporting their performance on specific skills or subtasks that they are still attempting to master or learn (Johnston, 2008; D. H. Rose et al., 2002). For example, if a teacher is trying to teach mathematical reasoning then a calculator would be an appropriate tool to scaffold the mathematical calculations, thereby allowing the child to focus on mathematical reasoning and problem-solving rather than on the computational manipulations. As the scaffolding is no longer needed, it would be removed in a process known as fading (Burke et al., 1998; Keel et al., 1999; Larkin, 2001; Ormond, 2006; D. H. Rose et al., 2002), until ultimately the student is able to independently perform all of the skills that comprise the complex process.

3. *Provide ongoing, relevant feedback* (Ormond, 2006). This is a critical component when teaching skills and strategies because students need to know if they are practicing effectively and they need to know what to do differently if and when their performance falters (D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003).
Furthermore, teacher feedback is crucial when students are trying to learn to apply strategies or learning in novel situations (Harris & Pressley, 1991; Lenz, 2006; D. H. Rose et al., 2002). Often students must be prompted to generalize strategies to new problem-solving contexts, and they may need feedback to help them adjust the strategy to suit the particular parameters of the problem situation. In addition to teacher feedback, students must develop self-monitoring techniques regarding their own learning. This reflective self-feedback allows students, over time, to develop the ability both to determine the quality of his/her performance and to identify potential steps to improve that performance. Thus, eventually the student becomes more independent and teachers are able to gradually release ownership of the learning to the students (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Burke et al., 1998; Carnine et al., 1997; Harris & Pressley, 1991; Lenz, 2006; Palinscar & Brown, 1984).

4. Offer flexible opportunities for demonstrating skills (Grossen et al., 2002; Joseph, 2006; Larkin, 2001; Lenz, 2006; Merrill, 2002; D. H. Rose et al., 2002). It is important to allow students flexible opportunities to demonstrate the skills they have been taught and to invite them to apply all parts of the process during the demonstration and performance of the skills (D. H. Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). For example, if students are sharing how they solved a mathematics problem, teachers should allow them to demonstrate their solutions using virtual manipulatives, pictorial representations, or other classroom manipulatives. These tools can help students express their mathematical solution while demonstrating that not everyone learns the same way.

Whenever possible, UDL recommends the use of digital technologies to supplement learning and expand the audience for students' ideas. This goal can be achieved through sharing a PowerPoint presentation or publishing on the web or on a school Webpage. These flexible

opportunities for students to share their expertise and knowledge with broader audiences can also increase their motivation (Johnston, 2008) which leads learners to "experience the 'why' of learning" and thus to begin to make affective connections to their lessons (D. H. Rose et al., 2002).

Principle 3. The third principle of UDL, multiple means *of engagement*, supports the diversity of the affective learning domain. This domain stresses that the level of attention students devote to a learning task or an activity depends on what attracts, motivates, or engages them (Meece, 2003; D. H. Rose et al., 2002). Meyer & Rose (2000) share some of the reasons that students do and do not learn:

Students learn for many reasons, including positive feedback and fascination with the material. The reasons students do not learn include little feedback or encouragement, poor match with teaching style, chronic failure and withdrawal of effort, inappropriate level of challenge, or lack of personal relevance of the material presented. (p. 42)

To support the diversity of the students' affective learning, it is imperative that students be provided with multiple options for engagement. The following four components help support the third UDL principle, multiple means of engagement.

1. Offer choices of content and tools (Meyer & Rose, 2000, p. 42). Permitting students to choose the content and tools with which to work can increase their engagement for learning a skill (Flowerday & Schraw, 2000; Meece, 2003). Furthermore, Rose, Meyer, Strangman, & Rappolt (2002), also note that when these skills link prior knowledge with strategic or recognition tasks, students are more likely to build skills, sustain interest in a topic (Dymond, Renzaglia, & Rosenstein, 2006; Flowerday & Schraw, 2000), deepen understanding, and pursue the extended practice necessary (Samuels, 2008) for the automatization of complex skills (D. H.

Rose, 2000; U.S. Department of Education Office of Special Education Programs, 2003). As an example of offering an alternative choice of content, students could be allowed to give a presentation regarding specific information about one of the 13 original colonies of their choice, rather than being assigned a specific colony. As an example of relating tasks to background knowledge, teachers could tie the skill of computing averages to the sport of bowling, baseball, or basketball. The foregoing examples are illustrative of the many simple, yet powerful, ways in which teachers can easily engage students in the learning process.

2. Provide adjustable levels of challenge (D. H. Rose et al., 2002). Teachers accomplish two goals by adjusting the level of challenge in their instructional assignments. First, by varying the level of challenge, teachers allow students to work in their zone of proximal develop (ZPD) where learning is just beyond their current ability but not out of reach (Rogoff, 2003; D. H. Rose, 2000; Tomlinson et al., 2003; USDOE, OSEP, 2003; Vygotsky, 1978; Wentzel & Watkins, 2002; Wertsch, 1988, 1991). The ZPD is the instructional area where students learn the best (Vygotsky, 1978) and because the level of challenge is neither too hard, which results in student frustration, nor too easy, which results in student boredom, the student maintains engagement (Sullivan, 2005). Second, by varying the level of challenge students are able to practice realistic goal setting. Both Rose, Meyer, Strangman, & Rappolt (2002) and Harris & Pressley (1991) point out that beyond engaging the student, providing varying levels of challenge also structures explicit opportunities for students to work on the goal setting process and provides opportunities to practice setting realistic goals

3. *Propose choices of rewards* (D. H. Rose et al., 2002; Williams & Stockdale, 2004). Offering students a choice of rewards addresses the fact that each student has his or her own idea of what constitutes a reward (Meyer & Rose, 2000; D. H. Rose, 2000; USDOE, OSEP, 2003).

While external rewards are often offered in classrooms, UDL specifically recognizes the importance of focusing on internal rewards (Cook, 2003). "Building students' meta-awareness of accomplishment and progress – an important tenet of UDL – may be one of the most effective ways to instill intrinsic interest in learning and support student's long-term engagement" (D. H. Rose et al., 2002).

4. Offer choices of learning context (Clarke & DiMartino, 2004; D. H. Rose et al., 2002; Wright, 2006). As with other learning preferences, a student's choice of learning context is also individual (Meyer & Rose, 2000; Rose 2000; USDOE, OSEP, 2003). For example, some students may prefer to work in small groups while others like the solitude of working alone. Likewise, some students like a lot of structure when given an assignment, while others like a less structured approach. Allowing students a range of learning materials and varying degrees of structure offers each student an opportunity to choose a learning context appropriate to his or her specific preference (Callahan, 1999; D. H. Rose et al., 2002; Wright, 2006).

Teacher Change and Innovation

While UDL appears to provide an approach to instruction that has benefits for both general and special needs students, it means little unless teachers are willing and able to implement such an approach. With that in mind, the following section features a discussion of teachers' resistance to educational change and innovation, as well as a consideration of the ways that educational reformers often seek to overcome teachers' resistance.

When talking about change and innovation Gersten, Chard, & Baker (2000) discuss two fundamental types of innovations: structural and core-of-teaching. Structural innovations include non-instructional changes that only tangentially affect classroom instruction (e.g., co-teaching, block scheduling). To implement changes at the structural level, it is critical to understand

district and state policies regarding practice as well as a local knowledge of the school culture. Variables such as schedules, time commitments, and available resources, among other items, all influence the types of structural change that might succeed (Gersten et al., 2000).

On the other hand, core-of-teaching innovations focus on the instructional practices (in this study "instructional strategies") that teachers use when implementing instruction in the core content areas (i.e., reading, writing, mathematics, and science) (Gersten et al., 2000). Addressing core-of-teaching innovations requires different considerations. Critical to the adoption of these types of innovations are teachers' understanding of and willingness to implement new content and pedagogical approaches. Knowledge of local school culture, while useful, may be minimally important (Gersten et al., 2000). For the purposes of this study, UDL entails a core-of-teaching innovation. Given the nature of this type of innovation, an effective professional development must: (1) target teachers' current use of instructional strategies that are consistent with UDL and their current knowledge of UDL; (2) address how UDL can be integrated and implemented most effectively into their current instruction; and (3) address pedagogical changes that would include altering instructional planning and student assessment to ensure that students are successfully meeting the goals and outcomes of the lesson.

For most teachers, changing the instructional methods they use to deliver instruction is difficult. Teachers tend to continue to use instructional strategies that are familiar to them. On this point, Greenburg & Baron (1999) remarked that teachers' habits pose the most pervasive barriers to change. Primarily the desire to stay with known instructional strategies that are considered "tried-and-true" is the result of avoidance or fear of failure in the face of implementing new methods (Fullan, 2001; Greenberg & Baron, 1999). Fullan (1993) notes that "Under conditions of uncertainty, learning, anxiety, difficulties, and fear of the unknown are

intrinsic to all change processes, especially at the early stages" (p. 25). Thus, even when teachers have the best of intentions and want to alter their instructional practices, change can be difficult (Fullan, 1993). Therefore, concern for increasing teachers' willingness to consider new content and pedagogical approaches to instruction are critical for implementing core-of-teaching innovations (Gersten et al., 2000).

A question that staff developers must consider in designing effective professional development programs is: "What is it that prompts teachers to consider new content and pedagogical approaches to change their instructional practices?" Both Fullan (1993) and Barth (2002) link teacher change to *moral purpose* or *moral outrage* respectively. These concepts focus on the teacher's recognition that his or her current instructional practices are not effective in reaching his or her students; and that changing those instructional practices will enable the teacher to become more effective in a manner that makes a difference in the lives of his or her students (Barth, 2002; Fullan, 1993). Additionally, teachers need to have the confidence that there is a better proven way to instruct students (Barth, 2002) and they need to believe that they are capable of implementing instruction using the new practice (Kosko & Wilkins, 2009).

For many teachers, changing their beliefs about the efficacy of particular instructional practices can be accomplished by attending professional development sessions. Such sessions can educate teachers regarding the barriers faced by students given the current instructional practices, while at the same time increasing both their knowledge of instructional practices that support students, especially those with special needs, as well as their belief that they can implement such instructional strategies. This is particularly important for general education teachers. In fact, Kosko & Wilkins (2009) found that teachers' participation in 8 or more hours

of professional development was more than twice as effective as less than 8 hours in improving teachers perceptions of their ability to adapt instruction for students with special needs.

At the same time, even when teachers have a desire to change their instructional practices to meet the needs of their students, there are additional barriers they may need to overcome. First, teachers are faced with many time constraints. They grade papers, attend meetings, complete reports, attend IEPs, supervise students in the cafeteria, and contact parents (Knight, 2009). These demands constrain the amount of time that teachers have available to spend on designing, creating and differentiating curricula to address the learning needs of the students in their classrooms (Jackson, Harper, & Jackson, 2001). Second, teachers face resource issues. There is an inequality of resources both between and within schools (Kantor & Lowe, 2007; Lucas & Beresford, 2010; Welner, 2010). This resource inequality can be in the form of the access to up-to-date textbooks, supplies, and technology (Darling-Hammond, 2004; Warschauer & Matuchniak, 2010; Welner, 2010). This is particularly true for special education teachers who may often be the last to receive access to resources that support the implementation of prescribed instructional methods (Gould-Boardman, Argüelles, Vaughn, Tejero-Hughes, & Klingner, 2005). This resource disparity means that teachers from different districts, or from different schools within the same district, or even from different disciplines within the same school, may not have the same tools or materials available to support students in accessing the general education curriculum. Third, teachers may face instructional demands that decrease their ability to make instructional decisions in the classroom (Jackson et al., 2001; Karl et al., 2007). Teachers may face testing pressures, curriculum demands based on school and/or district wide school improvement plans, or they may be required to follow pacing guides that determine what they will teach on a given day (Karl et al., 2007). These demands often leave little leeway for teachers

to practice the "art of teaching" where instructional decisions (e.g., differentiation of instructions, reteaching materials) are made at the classroom level (Jackson et al., 2001; Karl et al., 2007). Unfortunately, the aforementioned barriers can inhibit a teacher's ability to alter their instructional practices regardless of their desire for change.

Research on UDL

In this section a discussion of the research that addresses Universal Design for Learning in classroom practice will be shared. Overall, there is a dearth of empirical research that addresses UDL in classroom practice. There is some research concerning postsecondary level education (Campbell, 2004; M. V. Izzo, Hertzfeld, & Aaron, 2001; Reck, 2007; Silver-Pacuilla, 2006; Spooner & Baker, 2007) on a variety of aspects of Universal Design. As noted below, there is a very limited body of research on any topic concerning UDL at the kindergarten through twelfth grade level. The lack of empirical research makes it difficult to find, and therefore draw comparisons between, the findings of similar research. This is a problem that is further compounded by the fact that the definitions of UDL contained in the existing research are numerous and sometimes ill defined. While some of the Universal Design studies appear to define UDL in ways consistent with the operational definition contained in this paper (i.e., they follow the framework put forward by CAST, including the three principles of UDL noted above), there are many variations in the degree to which researchers adhered to the UDL model and its key features. Some researchers employed Universal Design of Instruction (UDI) (Campbell, 2004; Silver-Pacuilla, 2006; Silver, Bourke, & Strehom, 1998), which involved the implementation of nine primary principles taken from architecture (Scott, McGuire, & Shaw, 2003). Other researchers implemented UDL with additional components (M. V. Izzo et al.,

2001), while some researchers do not even operationalize UDL, making it very difficult to determine precisely what framework the researcher used (Spooner & Baker, 2007).

The lack of precision in operationalizing the UDL construct is a shortcoming that thwarts the development of an empirical and theoretical base with respect to UDL. The need to operationalize the UDL framework is an essential step to develop a uniform framework that can undergird the UDL curricular design process, making it possible to construct an accepted body of practices that support assessment, evaluation and validation through empirical evidence (McGuire, Scott, & Shaw, 2006).

A ProQuest database search was conducted to find articles concerning "Universal Design for Learning." That search found 99 such articles. Of those articles, only five studies (Abell, Jung, & Taylor, 2011; Eagleton, Guinee, & Langlas, 2003; Kortering, McClannon, & Braziel, 2005; Marino, 2009; Twyman & Tindal, 2006); met the necessary criteria to be relevant to this paper. That is, only five studies: (1) stated that they used the UDL curricular framework and operationally defined it consistent with the UDL curricular framework put forth by CAST (i.e., the framework utilized in this paper); (2) took place in kindergarten through twelfth grade classrooms; (3) included students with high-incidence disabilities (i.e., students with learning disabilities or behavioral disorders) and discussed those students in the findings, either as a separate category or in combination with the other subjects; and (4) were published in peer reviewed journals. A brief overview of those studies and the findings are reported below.

Twyman and Tindal (2006) examined whether a web-based history text was more effective than traditional textbook instruction; that is, whether it led to increased comprehension and problem solving skills for high school students with learning disabilities. A vocabulary matching probe and a maze task were used as the measures for measuring reading comprehension. To

measure problem-solving skills the researchers developed an extended-response problem-solving essay that consisted of two parts: summarization of the content, and an explanation of conditions necessary to bring about a given outcome. The experiment entailed a randomized control trial involving 24 LD high school students. The students in the experimental group received both textto-speech support (e.g., the text was read aloud) and digital text enhancements (e.g., hypertext links within text, graphic organizers, electronic glossary) to create flexibility with the text. The study took place in social studies classrooms. No statistical significance was found between the control group and experimental group relative to either improvements in reading comprehension or problem solving skills, but a statistically significant difference was found between the groups relative to the experimental group's improved vocabulary acquisition.

The second study, conducted by Marino (2009), examined the use of technology in a middle school, 6th through 8th grade, science curriculum. The instrument used in the study was *Alien Rescue*, an online technology-based astronomy curriculum created by researchers at the University of Texas at Austin, Texas A&M University, and the University of Louisiana at Lafayette. Marino hypothesized that the rigorous science content would encourage students to utilize the technology-based tools providing the researcher with the opportunity to understand the relationship between the use of those tools and learning. The tools were available within the program and were comprised of "text, illustrations, pictures, animations, videos, and graphic organizers" (Marino, 2009, p. 93).

The study lasted four weeks and employed several measures. These measures were: 1) a paper and pencil pre/post test assessment of the students' knowledge of scientific concepts, processes, and vocabulary; 2) six open-ended paper and pencil solution forms developed to assess the students' ability to analyze, synthesize, and evaluate scientific information; 3) the

Degrees of Reading Power (DRP) assessment was taken by each student to measure reading comprehension; 4) the use of each tool by each student was monitored, as students were each assigned a unique login and password. Students who took part in the study were placed into one of three reading groups based on their DRP reading level: (1) severe reading difficulties, defined by scoring at or below the 25th percentile [n = 126]; (2) poor readers, defined as scoring between the 26th and 50th percentiles [n = 205]; and (3) proficient readers, defined as scoring above the 50^{th} percentile [n = 822]).

The technology-based cognitive tools within *Alien Rescue* were grouped into one of four categories for this study: share cognitive load; support cognitive process; support out-of-reach activities; or support hypothesis testing. Separate one-way ANOVAs were conducted using one of the aforementioned categories as the independent variables and the DRP groups (either separately or with the severe reading difficulties and poor reading groups combined) as the dependent variable. Likewise, separate one-way ANOVAs were conducted using posttest scores as the independent variable and the DRP groups (either separately or with the severe reading difficulties and poor reading posttest scores as the independent variable and the DRP groups (either separately or with the severe reading difficulties and poor reading groups combined) as the dependent variable and the DRP groups (either separately or with the severe reading difficulties and poor reading difficulties and poor reading groups combined) as the dependent variable. No statistical significance was found in either tool use or posttest scores across the severe reading difficulties and poor reading groups.

However, when comparing low ability readers (i.e., severe reading difficulties and poor readers groups combined) with proficient readers, there was a statistically significant difference for three of the four tool categories. Low ability readers used the technology-based tools (i.e., share cognitive load; support cognitive process; support out-of-reach activities; or support hypothesis testing) less frequently than proficient readers, even though using the tools provided more benefits to the low ability group. That is, low ability readers gained .792 units on posttest scores for each unit increase in their use of tools that shared cognitive load, while proficient readers only realized an increase of .33. Additionally, tools that supported out-of-reach activities (e.g., allowed student to build and obtain data from authentic NASA probes) had a statistically negative impact on posttest scores. Some students accessed the out-of-reach tools so frequently that they did not focus on acquiring the necessary content area knowledge. The researcher suggested that, while the inclusion of tools is beneficial, teachers should monitor student use of those tools. Finally, proficient readers in this study benefited from tools that support hypothesis testing substantially more than students who had severe reading difficulties and those who were poor readers. Teachers and researchers during the study noted that students who struggled with reading also struggled with generating hypotheses. Thus they did not access the hypothesis test tools at the level of proficient readers.

The third study completed by Eagleton et al. (2003), was a narrative case study involving eight middle school language arts classes engaged in a research project. The students were required to use both print and Internet resources to do the research. The study focused on three aspects of research: choosing topics, asking research questions, and selecting key search terms. The students were required to research a personal hero. Students were allowed to self-select a hero for their project based on personal interest. In addition, students were required to present their research results in two different formats. Students selected the presentation format from a list that the teacher provided (e.g., diary, mock interview, video). The teacher also provided students with a rubric to help them work on goal-setting and self-assessment skills. No statistical data regarding the study's outcomes was provided and the study's conclusion essentially states that searching the Internet for relevant information is a hard task and particularly so for middle

school students. The research techniques employed in this study motivated most students to learn to do research on the Internet and the project allowed teachers to meet multiple instructional standards while integrating technology into the curriculum.

The fourth study employed a survey asking students how they enjoyed algebra and/or biology lessons presented with UDL interventions (Kortering et al., 2005). Eleven teachers and 320 students in two high schools located in North Carolina took part in this study. The teachers were trained in UDL interventions. The UDL algebra interventions included the use of PowerPoint presentations, Algebra 1 software to demonstrate concepts, and participation in games that helped students recognize algebraic properties. The UDL biology interventions centered on small group work, polling software to immediately assess student understanding of a genetics unit, and a teacher developed Webpage that provided notes, test review, and classroom information. When students participated in a UDL lesson (i.e., algebra or biology) they immediately filled out a form to provide feedback about the instruction. Results showed that the effectiveness, utility, and satisfaction related to the UDL biology and algebra classes were strong when compared to other non-UDL classes. (The authors did not define in their findings what they meant by the term "strong". They did not use statistical reporting measures to illuminate this finding and no specifics were given regarding the significance of any survey results.) The findings also showed that students self-reported learning useful and important information and staying on-task and working harder when they took part in lessons which included udl interventions. In fact, the study reported that 90% of the students wanted more UDL interventions, although the researchers presented no observational or achievement data to show that such instruction improved student learning.

The fifth and final study conducted by Abell et al. (2011) examined the survey results of 867 fifth through twelfth grade students regarding their perception of Universal Design for Learning being used in their classroom environments. The aforementioned students took the survey in the spring of 2007 near the end of the school year. Thus, they had almost a year of instruction on which to base their responses. The *Individualised Classroom Environment Questionnaire* (ICEQ) was modified and used for the survey. The questionnaire was examined using five variables: 1) personalization: extent to which students have opportunities to interact with the teacher; 2) participation: extent to which student participation is encouraged; 3) independence: extent to which students can make decisions and take leadership roles; 4) investigative: extent students develop inquiry-based skills; and 5) differentiation: extent to which instruction is individualized based on ability, interests, learning style, and work speed.

The researcher conducted a series of one-way ANOVAs to determine if there were any statistically significant differences in student perception of the learning environment in classes that employ UDL based on grade level (i.e., upper-elementary, middle school, or high school) or teacher gender. When examining student grade level in relationship to the students' perceptions of personalization, investigation, and participation, findings showed that high school students had significantly higher perception scores for the variables personalization and participation than did middle school and upper-elementary students. Additionally, upon further analyses it was found that middle school students had significantly higher perceptions scores for the researchers examined the variable participation than upper-elementary students. Next the researchers examined the variable teacher gender in relation to the students' perceptions of personalization, investigation, and participation across all grade levels (i.e., students were not aggregated by grade level). Student who had female teachers reported statistically significant higher perceptions scores for the variable

personalization than those who had male teachers. There was no statistically significant difference in perception scores for student who had female or male teachers for the variables investigation or participation.

These research studies are insufficient in number and breadth to indicate what needs to be done to develop a strong research base to determine the effectiveness of UDL in improving student learning. At this time, research has shown a variety of teaching strategies (e.g., providing explicit instruction, scaffolding student work, connecting new learning to prior knowledge) to be effective in improving student learning, and these teaching techniques are recognized as evidence-based practices (Allor et al., 2006; Burke et al., 1998; Carnine et al., 1997; Deshler et al., 2001; Englert et al., 2001; Gersten & Clarke, 2007; Harris & Pressley, 1991; Larkin, 2001; Okolo, 2006; Vygotsky, 1978). Further, these teaching strategies align with (i.e., comprise the ways to operationalize) many aspects of the three UDL principles (i.e., multiple means of representation, multiple means of action and expression, and multiple means of engagement). However, there is not an adequate research base to establish that the UDL curricular framework implemented as a whole (i.e., implementing all three principles together) forms a multi-layered and multi-faceted evidence-based practice. Therefore, continued rigorous research, where the constructs of UDL are operationally defined in a consistent manner, is necessary to determine if the UDL curricular framework, as a whole, can be considered an evidence-based practice (i.e., whether the implementation of the UDL curricular framework improves student performance). **Technology and UDL**

The previous sections described the general instructional strategies and principles that undergird the UDL framework. These strategies and principles can be implemented in classrooms to increase students' access to the curriculum, regardless of the subject matter,

curricular content, or teaching medium. This section focuses on how technology can support the UDL framework.

UDL is closely aligned with digital and computer technologies. Universal Design for Learning incorporates many aspects of technology and digital media as a means for scaffolding and individualizing instruction (D. H. Rose et al., 2002). Using technology and digital media, for example, provide instructional developers and teachers the ability to offer multiple representations and options for storing and presenting information in a nontextual way (D. H. Rose et al., 2005). Anderson-Inman and Horney (2007) stressed that moving from printed text to electronic text allowed students to gain meaningful access to the curriculum and overcame the barriers presented by printed text. One way that this can be accomplished is by providing struggling readers with digital supports that enhance comprehension and extend learning.

These supports include concepts such as "embedded supports (e.g., definitions of unfamiliar words), multiple modalities (e.g., text that can be read out loud), and links to useful resources (e.g., background information, concept maps, notepads) – all of which transform electronic text so that it is more accessible and supportive to diverse learners" (Anderson-Inman & Horney, 2007, p. 153). In addition, E. L. Higgins and Raskind (2005) assert that "... speech synthesis has become increasingly accepted as a means to compensate for reading disabilities" (p. 31). The idea behind synthesized speech is that persons who have difficulty with decoding print, or who have poor reading skills, often may not have difficulty with oral language, and using digitized speech is one way to compensate for such a reading weakness (Higgins & Raskind, 2005; Olofsson, 1992; Sorrell, Bell, & McCallum, 2007). The text-to-speech tool can help struggling readers access textbooks in the general education curriculum without being forced to use context as the only means for decoding text. By incorporating this technology into

reading practices, readers are allowed to maintain their reading speed (Olofsson, 1992) and focus on higher-level comprehension processing skills (Olofsson, 1992). Furthermore, Sorrell, Bell, and McCullum (2007) assert that speech synthesis software is becoming widely available. This is demonstrated by the ability to access free speech synthesis tools (e.g., Natural Reader, ReadPlease, HelpRead) by simply searching "text-to-speech" on the Internet. Consequently, access to this technology could be (but unfortunately is not) widely available in school systems today.

In addition to text readers, teachers can offer students the use of other technologies to support their writing. Computerized graphic organizers such as Inspiration© or Kidspiration© help students organize their ideas into different writing structures (Englert et al., 2007). Research has also shown that word prediction software programs can be beneficial for students who struggle with the writing process (Cullen, Richards, & Frank, 2008). Word prediction programs help writers who struggle with spelling by providing word choices based on the initial letter of a word. They scaffold student's writing by providing spelling support and allowing the student to focus on other aspects of the writing process (Lankutis & Kennedy, 2002).

Through the use of technology and digital media, teachers can provide the balance necessary to create optimum learning opportunities for all students (Curry, 2003; Gersten et al., 2006; Pisha, 2003; Rose, Hasselbring, Skip, & Zabala 2005), and creating optimum learning opportunities is at the core of both the UDL framework and sociocultural theory.

Summary of Literature Review

In summary, the sociocultural learning theory informs the UDL framework to help teachers understand that they need to develop meaningful curriculum to address the concept that student competence is not a static condition that resides within an individual but rather is an ever

changing condition that can be fostered by an appropriate learning situation (Rueda et al., 2000; Vygotsky, 1978). In this new paradigm, the UDL framework shifts the instructional focus to removing barriers in the curriculum that interfere with a student's academic success. This is done in an intentional and systematic way by making deliberate choices about instructional delivery and by presenting meaningful and challenging activities that support not only student access to, but the learning of, the curriculum (King-Sears, 1997; D. Rose et al., 2000a; Rueda et al., 2000; Vygotsky, 1978). This intentional instruction includes such techniques as mediated instruction, scaffolding, and providing students with work in their specific, individual zone of proximal development.

In addition, the use of technology provides further support for students in the UDL framework. Technology can function as a means to provide the support of a more knowledgeable other (Curry, 2003; Englert et al., 2004; Englert et al., 2007), to mediate performance, enable students to access information (Okolo, 2006), and to attain advanced performance levels (Englert et al., 2007; D. H. Rose et al., 2005).

Although UDL appears to be a promising way to improve instruction for all students, there is still much research that needs to be done to determine the effectiveness of UDL in the classroom. Research on the total concept of UDL is extremely limited, although the underlying principles that create the foundation of the UDL framework are themselves built on evidencebased practices. With continued rigorous research of the UDL curricular framework it should be possible to determine if it can be considered an evidence-based practice in its own right.

Additionally, it is important to remember that instructional change (i.e., innovation) is difficult to achieve (Fullan, 1993, 2001; Gersten et al., 2000; Greenberg & Baron, 1999). Even when teachers have the desire to change they may encounter barriers outside of their control (i.e.,

time constraints, resources, and instructional demands) which may inhibit their ability to see change through (Gould-Boardman et al., 2005; Jackson et al., 2001; Kantor & Lowe, 2007; Karl et al., 2007; Knight, 2009).

Purpose of Study

The purpose of this mixed methods study is to investigate which instructional strategies that align with the principles of Universal Design for Learning are implemented by teachers in their instruction and if, and to what extent, their self-declared knowledge about the concept of UDL influences the type of instructional strategies implemented and the frequency of that implementation. To date, the amount of empirical research on UDL is limited and does not consider that many instructional strategies that align with UDL principles are implemented by teachers in Kindergarten through Twelfth grade classrooms irrespective of, and without regard to, the conceptualization and evolution of UDL. That is, many of the instructional strategies underlying the principles of UDL involve methods of effective teaching that were known to, and utilized by, good teachers before anyone articulated the concept know as UDL and these methods of effective teaching (i.e., instructional strategies) continue to be used by good teachers independent of, and without regard to, the evolution of UDL or the teacher's knowledge of UDL. However, it is reasonable to hypothesize that a teacher's knowledge of UDL may: (i) increase the likelihood of the teacher using an instructional strategy consistent with UDL; and/or (ii) influence the type of instructional strategy implemented; and/or (iii) increase the overall frequency of the implementation of such strategies.

This research provides three pieces of information that can inform both future research concerning UDL and the professional development of educators regarding UDL. The first piece of information provided is a "snapshot" of the type of, and extent to which, (self-reported)

instructional strategies consistent with UDL are implemented by actual classroom teachers. The second piece of information provided is the level of (self-reported) knowledge about UDL possessed by actual classroom teachers. The third piece of information provided addresses whether there is, or is not, a difference between a classroom teacher's (self-reported) knowledge of UDL and the type and extent of that teacher's (self-reported) implementation of instructional strategies consistent with UDL.

The first piece of information is important because research concerning UDL should consider the extent to which educators are already implementing instructional strategies consistent with UDL. If, as expected, educators are already implementing such strategies this information may inform the design of future studies (e.g., by suggesting the benefits of designing a research approach to capitalize on an educator's existing use of instructional strategies consistent with UDL). Likewise, knowing the level of self-reported knowledge about UDL could be important to the development of certain future studies considering various aspects of UDL and its implementation. Such information provides insight into the educators who will be involved in those studies. Lastly, the third piece of information is important because determining whether a difference between self-reported knowledge of UDL and the self-reported use of instructional strategies consistent with UDL is found, or is not found, should be valuable in designing future studies of UDL (e.g., if there is no difference, it will suggest that mere knowledge of UDL is not sufficient to lead to an increase in the actual implementation of strategies consistent with UDL; while finding a difference would suggest the opposite, but would not necessarily mean that such implementation is undertaken in an intentional manner in an effort to achieve the goals of UDL).

Moreover, each of these three pieces of information will be extremely useful in designing programs for the professional development of educators concerning the classroom implementation of the principles of UDL. For example, knowing which instructional strategies consistent with UDL are currently utilized will provide an opportunity to use such strategies as springboards to introduce educators to the principles of UDL, make those principles more accessible and acceptable to the educators and, finally, to make the educators more open to utilizing other, currently unused, instructional strategies consistent with UDL. Further, knowing what educators in the field know, or believe they know, about UDL provides assistance in determining what common understanding exists between those providing the professional development and the educators who will be receiving that training. The existence of a correlation between (self-reported) knowledge of UDL and (self-reported) implementation of instructional strategies consistent with UDL, or the lack of such a correlation, will provide assistance in the optimum design of a professional development curriculum. Overall, these three pieces of information will allow the professional development trainers to present the concept of UDL in relationship to a teacher's existing knowledge rather than as a new and foreign concept and would allow for deeper conceptualization of the UDL curricular framework.

The UDL curricular framework does not take a "cookbook" approach to instructional design. Rather, the framework requires intentional planning, prior to instruction, where teachers select instructional strategies that support the diverse learning needs of the students in their classroom. To date, the minimal UDL research that has been conducted focuses on training teachers to use specific UDL interventions during instruction with their students and/or by comparing digital text (e.g., web-based history text, Internet research resources, teacher developed web page) to print (e.g., traditional textbook), through the incorporation of technology

or digital media (e.g., text-to-speech, hypertext links, electronic glossary, video, PowerPoint presentations, software) (Eagleton et al., 2003; Kortering et al., 2005; Twyman & Tindal, 2006). While this research undoubtedly addresses important aspects of UDL, in other respects it appears to constitute a "cookbook" approach to the implementation of the UDL curricular framework. To move the concept of the UDL curricular framework forward it is critical to investigate the instructional strategies that teachers currently implement in the classroom, and through future research and training, to help teachers learn to intentionally select instructional strategies that will support the diverse learning needs of their students.

Research Questions

This study seeks to answer the following questions about teacher implementation of instructional strategies that align with the Universal Design for Learning framework. It further addresses the use of technology in the classroom as it is applied to the implementation of these instructional strategies.

- 1. What is the type and frequency of teacher self-declared implementation of instructional strategies that align with the UDL principles?
- 2. What is the teacher's self-declared knowledge of the UDL principles and what is the difference, if any, between that level of self-declared knowledge and the level (considering both type and frequency) of the self-declared implementation of instructional strategies that align with UDL principles?
- 3. What is the type and frequency of teacher self-declared use of technology for the implementation or completion of instructional strategies that align with the UDL principles?

CHAPTER 3

METHODS

Research Design

This research study employed a survey and follow-up interview developed by the researcher. The survey provided data that allowed the researcher to examine the self-reported instructional practices that participating educators use during instruction and to assess teacher familiarity with the Universal Design for Learning (UDL) framework. The follow-up interview allowed the researcher to gather additional in-depth information from certain survey respondents about the use of instructional practices and their familiarity with UDL. This sequential mixed-methods study provided both quantitative (survey) and qualitative (open-ended survey questions; interview) data to allow for data triangulation (Lodico, Spaulding, & Voegtle, 2006; Teddlie & Tashakkori, 2006).

Survey data was collected using Survey Gizmo, an online survey tool, and interviews were conducted via telephone. All survey respondents who agreed to participate in the interview and returned their letter of consent were interviewed.

Setting and Participants

Setting. School districts across one Midwestern state were asked to participate in this study. Statewide there are 848 Local Educational Agencies (public and private school districts), 3,711 schools (U.S. Department of Education, 2010), and 96,204 teachers (IES National Center for Education Statistics, 2008).

Survey participants sample size. The target population for the survey portion of this study included both general education and special education classroom teachers who teach Kindergarten through Twelfth grade and who are public school teachers. A request to participate

in the study was sent to 552 public school districts. The districts were asked if they would be willing to disperse the survey to Kindergarten through Twelfth grade teachers in their district. Five districts agreed to participate and those districts were sent an email with the embedded survey link to disperse to their Kindergarten through Twelfth grade teachers.

The survey was sent to approximately 828 teachers and 57 of those teachers completed and submitted the survey. An additional 29 teachers partially completed their surveys but these surveys were never submitted and 11 other survey respondents started the survey but did not meet the study criteria (i.e., they were support staff who did not qualify to participate in the survey) and were precluded from completing the survey.

There were 57 surveys submitted. However, for data analysis purposes, the final sample of 57 respondents was narrowed to 56 respondents due to the amount of missing data from one respondent's survey. The respondent whose data was not analyzed left 27 of the 87 questions (i.e., 31%) unanswered. The researcher felt that the number of unanswered questions was significant enough to render the submitted survey incomplete and thus unusable.

Interview Participants Sample Size. The 56 Kindergarten through Twelfth grade teachers who submitted completed survey responses were the target population for the interview portion of the study. Once the survey was closed these teachers were emailed and informed of the date that the survey incentive drawing would take place and were also asked to contact the researcher if they would be interested in taking part in a 25 – 35 minute telephone interview.

Online Survey Design

Survey Gizmo was the online survey tool used to implement the survey portion of this study. When building the online survey several design features were considered to enhance respondents' ease of response and completion of the survey. The survey included a welcome

page that described the purpose of the survey, addressed respondent anonymity and confidentiality, made clear that the respondent could stop participation in the survey at any time, and explained the chance to enter a drawing to win an incentive.

The initial survey questions were short and simple; answering them only required the use of radio buttons and short answer open-ended questions (i.e., the questions required a numerical or a one to two word response). This design was purposeful as abandonment usually occurs early in a survey and if responses are too complicated, or necessitate lengthy answers, respondents infer that the entire questionnaire will be similar and are less likely to complete the survey ("Designing and Developing", 2007). Additionally, several survey questions were hidden, based on skip logic (or if-then reasoning), and were revealed only if the questions become relevant based on a respondent's prior answer (e.g., Can you name the 3 principles of UDL: yes/no; if yes is selected then the question "List the 3 principles of UDL" becomes visible to that respondent). The use of skip logic allowed the researcher to collect crucial data without overburdening the individual respondents (Nelson et al., 2004).

Navigation guides, consisting of a progress percentage bar and navigation buttons, were used to decrease the respondents' frustration which can also lead to abandonment during the survey ("Designing and Developing", 2007). The progress percentage bar helped respondents determine their location within the survey and provided clear information about how far they were from the end of the survey. Navigation buttons were also added in a consistent manner to each page to help respondents advance through the survey without frustration. A "save and continue survey later" button was added to allow respondents the opportunity to leave the survey and continue it at a later time.

Survey Instrument Design

After an initial survey was constructed the researcher asked peers (i.e., PhD students in the special education department of the same university) to review it for clarification of content and provide feedback about items that could be problematic (Aldridge & Levine, 2001). Changes to the survey were made based on the feedback from the group. A pilot study, comprised of 17 teachers, was then conducted using the revised survey to determine if there were other problematic areas. Based on feedback from the pilot study respondents a key change was made to the survey for this study.

That change involved moving all of the questions pertaining to UDL to the end of the survey. According to spontaneous comments from some of the pilot study respondents, the UDL questions near the start of the survey made them nervous about their answers throughout the questionnaire. They felt that there was some particular way in which they should be answering the survey questions. Furthermore, there were potential respondents in the pilot study pool who mentioned that they started the survey but stopped once they encountered the questions about Universal Design for Learning because they incorrectly assumed that knowledge regarding UDL was necessary to complete the questionnaire and they felt they lacked this required knowledge. The foregoing feedback strongly indicated that the flow of the questions in the survey inhibited both the responses of the respondents and the response rate (deVaus, 2002). Therefore, the order of the questions was changed in the final iteration of the survey with all of the questions relating to UDL being placed at the end of the survey.

Question composition. Respondents were asked to complete a survey requiring the following types of responses: 14 multiple choice questions which allowed the respondent to select only one answer (e.g., Select the level of your degree); 2 Likert scale questions which

allowed respondents to select one answer (i.e., I am familiar with the term "Universal Design for Learning; When creating lesson plans I think about the learning difficulties students face... and I make revisions to the lesson prior to instructing my students: Strongly agree to Strongly disagree); 3 multiple response questions which allowed respondents to select all answers that applied to them (e.g., What level do you teach at: elementary, middle school, high school); 6 short answer open-ended questions that required only a numerical response or a one to two word response (e.g., Years as a teacher; endorsement); 11 open-ended questions that required at least a sentence length response (e.g., What do you think Universal Design for Learning means?); and 51 frequency questions (e.g., Rate your use of: *modeling/demonstration*: several lesson a day, a lesson daily, several lessons a week, a lesson weekly, several lessons a month, a lesson monthly, Not/Applicable, Don't Know) to assess their classroom instructional practices and to assess their familiarity with Universal Design for Learning (UDL). (See Appendix A for the Survey.)

The researcher designed the survey by looking separately at the components that comprise the three UDL principles and selecting instructional strategies that fell within these components to create the 38 UDL frequency questions for the survey. (See Tables 3, 4, and 5 below.) This was accomplished by using the *Examples of UDL Solutions* forms from the *Teaching Every Student in the Digital Age: Universal Design for Learning* book (D. H. Rose et al., 2002, pp. 191-193) which provide examples of instructional strategies that fit under each of the components that form the three UDL principles. Table 3UDL Principle 1: Multiple Means of Representation Components and Underlying InstructionalStrategies

UDL Principle 1: Components	Underlying Instructional Strategies
Provide multiple examples:	Examples of patterns/concepts
Stress/Highlight critical features:	Non-examples of patterns/concepts Present materials using two modalities Present materials using three or more modalities Supports (e.g., graphic organizers) for key features Prompts and cues to recognize critical features Connection between types of information (e.g., text/charts)
Supply multiple media and formats:	
Support background knowledge:	Varied instructional materials Multiple print formats Auditory media (e.g., tapes, CDs of textbooks) Visual media (e.g., DVD, video clip) Connect learning to what students already know Teach background information (e.g., define vocabulary) Instructional materials in student's first language

Table 4

UDL Principle 2: Multiple Means of Action and Expression Components and Underlying Instructional Strategies

Supply flexible models of skilled performance:

	Product model (e.g., example of finished product)
	Process model (e.g., steps in pre-writing)
	Supply different models for reaching goals
Provide multiple opportunities to pra	ctice with supports:
	Provide items to structure work
	Use scaffolds to support learning goals (e.g., spell check)
Provide ongoing, relevant feedback:	
	Provide guides (e.g., rubrics) to evaluate quality of work
	Provide calendars, timelines to guide work completion

Table 4 (cont'd)

	Student self-monitor work completion				
	On going feedback in multiple formats				
Offer flexible opportunities for demonstrating skills:					
	Student learning shared beyond classroom				
	Supports to express/explains answers				
	Multimedia to demonstrate knowledge				

Table 5

UDL Principle 3: Multiple Means of Engagement Components and Underlying Instructional Strategies

UDL Principle 3: Components	Underlying Instructional Strategies			
Offer choices of content and tools				
	Student choice of content (e.g. book to read; report topic)			
	Student choice of tools (e.g., word processor or write by			
	hand)			
	Relate task to student interest			
	Choice of activities to demonstrate learning			
Provide adjustable levels of challeng	je			
	Provide varying levels of challenge for assignments			
	Students choose resources to use as needed			
Propose choices of rewards				
	Students allowed choice of rewards for accomplishing goals			
	Provide individualized feedback to support student learning			
	Provide grade guidelines			
	Students have opportunities to demonstrate learning			
Offer choices of learning context				
-	Choice of flexible work groups (e.g. pairs, small group)			
	Options for feedback			

Survey sections. Research respondents were asked to complete a questionnaire comprised of seven sections, with the specified sections being designed to elicit the following information: 1) respondent's demographic information; 2) respondent's self-reported use of multiple means of representation during instruction (UDL Principle 1); 3) respondent's self-reported use of multiple means of action and expression (UDL Principle 2); 4) respondent's self-

reported use of multiple means of engagement (UDL Principle 3); 5) the types of technology respondent's self-reported using during instruction and for lesson completion; 6) instructional supports to address student's needs that respondents self-reported as incorporating during lesson planning rather than merely implementing after instruction takes place; and 7) respondent's self-reported familiarity with UDL.

Survey organization. The survey was broken down into 12 online pages to address particular content. After the welcome page, which included the teacher participation and consent form, the first section of the survey (pages 1 – 5) focused on respondent demographics at the district and classroom level. The second, third, and fourth sections of the survey assessed, respectively, the instructional strategies respondents self-reported they employ in the classroom (page 6), the strategies respondents self-reported they implement that support student learning (page 7) and the strategies respondents self-reported they implement to address student engagement (page 8). Section five of the survey (page 9) examined the technology respondents self-reported they use to support the implementation of instructional strategies consistent with UDL in the classroom. Section six of the survey (page 10) posed lesson planning questions while section seven of the survey (pages 11 and 12) addressed the respondent's self-reported knowledge of UDL. Table 6 shows the intersection of the survey sections and survey organization, and provides information about the number, types, and examples of questions for each section of the survey.

Table 6

Iı	ntersection	of O	nline S	Survey	Sections	with	Corresi	onding	Ouesti	ion
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Survey Sections:	Online Survey Sections:	No. of Questions ^a , Type, and Examples
Participants	Section 1 –	12 Multiple choice – Is your school:
demographic	Demographics at the	Urban, Suburban, Rural;
information	district and classroom	3 Multiple response – What level

Table 6 (cont'd)

	level	do you teach at: Elementary School, Middle School, High School; 5 Short answer open-ended – At what grade level do you teach this year? 1 Open-ended – With whom do you collaborate [when planning lessons]?
Teacher's familiarity with UDL	Section 7 – Knowledge of UDL	 2 Multiple choice – Have you received professional development in the UDL framework; 1 Likert scale – Rate: I am familiar with the term Universal Design for learning; 1 Short answer open-ended – Number of days of Professional development; 4 Open-ended – What do you think Universal Design for Learning Means
Multiple means of representation during instruction	Section 2 – Instructional strategies teachers employ in classroom	 14 Frequency – Rate your use of: Rephrasing Instruction; 1 Open-ended question – Top 3 multimodal teaching strategies used
Multiple means of action and expression	Section 3 – Strategies that address student learning	 12 Frequency – Rate your use providing guides to break long term projects into smaller steps 1 Open Ended – Top 3 ways students present learning using multiple media/formats
Multiple means of engagement	Section 4– Strategies that address student engagement	 12 Frequency – Rate your use of: Relating task to student's interest; 2 Open-ended – Top 3 ways you allow students to choose their content
Technology used to provide access to the general education curriculum	Section 5 – Technology teachers use to support the implementation of UDL in the classroom	 13 Frequency – Rate your use of: Predictive writing programs; 1 Open-ended – Top 3 software programs you use to support student learning

Table 6 (cont'd)

Instructional changes Section 6 – Lesson occurring during lesson planning 1 Likert scale – Rate: When creating lesson plans I think about the learning difficulties students face... and I make revisions to the lesson prior to instructing my students;
1 Open-ended –What steps do you take to ensure student success when planning your unit/lesson?

^a The number of questions includes those that are hidden when irrelevant.

Survey Implementation Procedures

Participant contact email. The online survey was administered using Survey Gizmo, a web-based application. The potential respondents were sent the survey link via an email from a representative of their school district. The email contained a short description of the survey with a time estimate for completion, information about the participation incentive and an embedded link to automatically direct the recipient to the survey.

Strategies to maximize response rate. Several strategies were implemented to maximize the survey response rate. First, the researcher used incentives to try to increase participation. Prospective respondents were informed in an email and on the consent form that there was a drawing to win one of 50 ten-dollar e-cards, 2 twenty-five dollar e-cards, or 2 fifty-dollar e-cards. The last page of the survey provided survey respondents with an opportunity to enter the drawing. Respondents were informed that participation in the drawing could not be linked back to their survey data thereby allowing them to retain their anonymity. If respondents elected to participate in the drawing they were sent to a second online survey where they were required to provide their email address and select which gift card, either an iTunes or an Amazon

e-card, they would like to receive if they won. Once the information was submitted the respondent was entered in the drawing.

Second, the survey was created with a "return and finish survey later" option provided in Survey Gizmo. This allowed respondents to return to the survey where they left off if they were interrupted or if they desired to finish the survey at a later time. Additionally, this option allowed the designer to have reminder emails sent every two days to the email address the respondent provided when the "return and finish survey later" option was chosen.

Third, potential respondents were provided with up to three opportunities to choose to participate in the survey. As noted, information regarding participation in the survey was emailed to all Kindergarten through Twelfth grade teachers in participating public school districts via the district contact person. Two-weeks later a second email was sent out to the same individuals from their district representative. This provided potential participants with a reminder to participate in the survey (Dillman, 2000), as well as serving as an additional reminder to finalize the survey for those who had started, but not yet completed, it. Due to the low response rate a third email was also sent out to participating district representatives to request that they resend the survey to their teachers.

Interview Instrument Design

The structured interview was similar to the survey, but the open-ended questions were designed to help the researcher gain a deeper understanding of the specific instructional strategies that align with the UDL principles and technology teachers actually implement in their classroom and to garner information about whether teachers in the survey were familiar with the UDL framework and, if applicable, to determine how their familiarity with UDL shaped their instructional practices.

Interview sections. The interview was broken down into six sections designed to elicit information from the interviewees on the topics set forth in the following paragraph (See Appendix B for the interview questions).

Interview organization. The first section of the interview's six sections focused on the interviewee's demographics at the classroom level. The second section addressed the interviewee's proactive planning for student diversity during lesson or unit development. The third section assessed the interviewee's familiarity with UDL. If the interviewee indicated knowledge of UDL and stated that he or she had received training about UDL then the researcher asked additional detailed questions about UDL implementation (contained in the fourth section of the interview). The fifth section of the interview addressed the interviewee's classroom implementation of both instructional strategies that align with the UDL principles and technology. In the final section of the interview, the interviewee was asked to: (1) consider the instructional strategies that align with the UDL principles and technologies he or she had indicated were implemented in the classroom; and (2) assess how he or she felt these strategies and technologies affected students in terms of both learning and behavior.

Interview Implementation

Participant contact. As stated above once the survey was closed respondents were emailed and informed that the survey incentive drawing would take place and they were also asked to contact the researcher if they would be interested in taking part in a 25 - 35 minute telephone interview. This was the only contact the researcher was permitted to make with the respondents in order to enlist interview participants.

Four teachers responded to the noted email stating that they would like to take part in the interview portion of the study. They were contacted via email and asked to sign and return a

letter of consent. Three teachers signed and returned the letter of consent. The fourth teacher did not sign and return the consent letter nor did that individual respond to several efforts on the part of the researcher to contact him/her after his/her initial email stating he/she would like to participate in the interview. Consequently, the fourth teacher did not take part in the interview portion of this study.

Strategies to maximize response rate. The respondents were offered an additional incentive to participate in the interview. This information was included in the initial email that was sent requesting participants to take part in the interview. Survey respondents who agreed to participate in the interview were incentivized with either a \$10 iTunes or Amazon e-card. Once the interview was completed they received the incentive of their choice.

CHAPTER 4

DATA ANALYSIS

Data analysis was conducted using both quantitative and qualitative measures to analyze: the respondent's self-reported familiarity with UDL; assess the respondent's self-reported implementation of instructional strategies that align with the three UDL principles; determine the frequency of those self-reported instructional strategies; and determine the technology selfreported by the respondents as being used during instruction and for lesson completion to support the implementation of the instructional strategies that align with the UDL principles. The qualitative analysis of the data (i.e., open-ended survey questions and interviews) was used to triangulate the results of the quantitative analysis.

The data was examined to determine the difference between a respondent's expressed familiarity with UDL and his or her self-reported implementation of instructional strategies that align with the UDL principles ("UDL instructional strategies"). The researcher looked at four possible patterns of response, namely: 1) a professed high level of familiarity with UDL with a low level of self-reported classroom use of UDL instructional strategies and/or technology; 2) a professed low level of familiarity with UDL with a high level of self-reported classroom use of UDL instructional strategies and/or technology; 3) a professed high level of familiarity with UDL with a high level of self-reported classroom use of UDL instructional strategies and/or technology; or 4) a professed low level of familiarity with UDL with a low level of self-reported classroom use of UDL instructional strategies and/or technology; or 4) a professed low level of familiarity with UDL with a low level of self-reported classroom use of UDL instructional strategies and/or technology; or 4) a professed low level of familiarity with UDL with a low level of self-reported classroom use of UDL instructional strategies and/or technology.

Additionally, the researcher quantitatively analyzed survey data arising from open-ended questions such as: which instructional strategies do teachers use to present lessons (UDL Principle 1); which instructional strategies do teachers employ to support student action and
expression (UDL Principle 2); which instructional strategies do teachers apply to engage students (UDL Principle 3); and what technology do teachers utilize to work with students in the classroom.

Exploratory Data Analysis

SPSS software was used to code and analyze the quantitative survey data. After entering the data, an exploratory data analysis (EDA) was conducted to examine the data for potential problems to allow necessary corrections to be made before statistical analysis was conducted (Leech, Barrett, & Morgan, 2008). To conduct the EDA, descriptive statistics were conducted to check the accuracy of the entered data. To verify accuracy of the data the minimum and maximum values, mean, and the missing values of the data were examined. The minimum and maximum values were examined to make sure all data were entered within the correct value range. The mean was checked as a secondary measure to ensure that data were entered correctly (i.e., a mean that appeared to be too high or low would indicate a need to reevaluate the entered data). The missing values were analyzed to make sure that no respondent's data was inadvertently omitted. Problems in any of the aforementioned areas would indicate that some data has been coded incorrectly and needed correction before the data was subjected to further statistical analysis.

Assumptions and Reliability

Once the data was determined to be accurate, the next stage of analysis was to conduct checks for statistical assumptions and reliability.

MANOVA assumptions. In order to conduct a MANOVA data must meet four assumptions. First, there must be independence of observations (meaning that each respondent's scores are independent of every other respondent's scores). Second, there must be multivariate

normality to establish that there is a linear relationship (i.e., linearity) between any two dependent variables and that there is normality of each variable and all subsets of the variables. Third, there must be homogeneity of variance/covariance across groups to establish that the variances for dependent variables are approximately equal in all groups. Furthermore, the covariance between pairs of dependent variables should be approximately equal (Leech et al., 2008). It is important to note that the MANOVA is robust to both violations of multivariate normality and violations of homogeneity of variance/covariance if groups are of nearly equal size. Leech et al. (2008) state that the *N* of the largest group should not exceed 1.5 times the *N* of the smallest group. The fourth and last requirement is that the correlation between dependent variables are moderately correlated (i.e., in the range of .40 to .60). If the dependent variables are less than moderately correlated, the MANOVA would normally not be the appropriate statistical test to analyze the data. If dependent variables are highly correlated (i.e., above .60) it is necessary to create a composite variable with the highly correlated dependent variables or to exclude one of the highly correlated dependent variables from the MANOVA.

The first data assumption, independence of observations, is a design issue and was addressed in the study design (i.e., the electronic survey was intended to be taken by an individual and submitted). Descriptive statistics on UDL Instructional Strategies for Principle 1, 2, and 3, and technology variables, aggregated by low and high levels, were conducted to examine cell size and determine whether cells were within a 1:1.5 ratio to compensate for either multivariate normality (i.e., the second data assumption) or homogeneity of variance/covariance issues (i.e., the third data assumption). Additionally, with respect to the third data assumption, Box's M test and Levene's statistic were checked to look for problems with homogeneity of variance/covariance (Leech et al., 2008). With respect to the fourth data assumption, a Pearson

Correlation was conducted to determine if the dependent variables were moderately correlated (collinearity) and to assess whether multicollinearity existed between pairs of dependent variables.

Chi-square assumptions. In order to conduct a Chi-square test data must meet two assumptions. First, the expected frequencies for each category should be at least one. Second, there should not be more than 20% of the categories with expected frequencies of less than 5 (IBM, 2010).

Reliability. Cronbach's Alpha was computed using SPSS to assess the internal consistency of items in the research survey (Gersten et al., 2005; Leech et al., 2008). Gersten et al., recommends coefficient alpha reliabilities of at least .60. In the pilot study, the 35 items that were summed to create the Total UDL Principles scale had an alpha of .82. This indicated that the items formed a scale with good internal consistency. Likewise, in the pilot study an identical .82 alpha for the Total UDL Principles and Technology scale also indicated a good internal consistency. Additionally, in the pilot study separate scales were created for UDL Principle 1, UDL Principle 2, UDL Principle 3, and Technology. The alpha for the UDL Principle 1 scale was .60 which indicated reasonable internal consistency reliability, while the alphas for the UDL Principle 3 (.75) and Technology scales (.78) indicated good internal consistency.

For this iteration of the survey there were 38 items summed to determine the alpha for the Total UDL Principle scale. Total UDL Principles (38 items) and Technology (13 items; 51 items total) were also summed to determine their internal consistency. In addition, individual scales were created to determine the respective alphas for UDL Principle 1 (14 items), UDL Principle 2 (12 items), UDL Principle 3 (12 items), and Technology (13 items). The alphas for the

components of UDL 1, 2, and 3 were also determined. Each UDL Principle had 4 components and the number of items used to calculate the alpha for each component varied from 2 to 4 items.

Interrater reliability. Coding (Kent, 2001) for all open-ended survey questions that were used in the quantitative analysis underwent interrater reliability. Two raters independently looked at the data and assigned them to the pre-determined categories to which each felt the data corresponded. Once each person coded the data, the researcher compared the tables and looked for areas of disagreement. Reliability was computed by dividing the total number of the raters' agreements (both coded and uncoded) by the total codes possible. All reported percentages of interrater reliability used the initial rating scores with the original raters' disagreements. However, prior to the use of the data in any statistical analysis, the raters discussed all areas of disagreement and came to a consensus about how the information should be coded. The codes were then changed accordingly.

Generation of Data for Quantitative Analysis

Source of Raw Data. Data for quantitative analysis was generated from the responses to Likert scale questions and some of the open-ended survey questions that were converted to quantitative data.

Teacher's self-reported familiarity with UDL. The respondent's professed level of familiarity with UDL was evaluated using: (i) a Likert scale question that allowed the responder to self-evaluate his or her familiarity with UDL; and (ii) three open-ended survey questions that were coded as quantitative measures (i.e., What do you think UDL means? What are the three principles of UDL? How much UDL professional development have you attended?).

Self-evaluation of familiarity with UDL. The respondents were asked to indicate their level of agreement with the statement "I am familiar with the term "Universal Design for Learning."

This question was developed as a frequency question that provided five response categories from which to choose. These categories were entered into SPSS using the following values: If there was no response to the question, the question was assigned a value that indicated that the data was missing, and the response was not included in the data analysis; "Strongly disagree" was coded as a -2; "Disagree" was coded as a -1; "Undecided" was coded as a 0; "Agree" was coded as a 1; and "Strongly agree" was coded as a 2. The mean scores for this quantitative Likert scale frequency question were between -2 and 2.

Meaning of UDL. The open-ended survey question, "What do you think UDL means?" was coded (Kent, 2001) into a quantitative 4 point scale: (0) - does not know; (1) - low familiarity;(2) - some familiarity; (3) - high familiarity; based on the respondent's written reply. The criteria used to evaluate and code the responses to the question were:*creating instructional changes at the planning stage; addressing the learning of all students; and eliminating the need to modify or alter assignments after initial instruction.*If a respondent's written reply evidenced knowledge of none of the three concepts, it was coded as <math>(0) - does not know; if a respondent's written reply evidenced so written reply evidenced knowledge of any one of the three concepts, it was coded as <math>(1) - low familiarity; if a respondent's written reply evidenced knowledge of any two of the three concepts, it was coded as (2) - some familiarity; if a respondent's written reply evidenced knowledge of all three of the concepts, it was coded as <math>(3) - high familiarity.

Three principles of UDL. The second open-ended question, "What are the three principles of UDL?" was also coded into a quantitative 4 point scale: (0) – Knows no principles; (1) – Knows one principle; (2) – Knows two principles; (3) – Knows three principles. These questions were coded by simply counting the number of UDL principles that respondents correctly wrote down.

UDL professional development. The third and final open-ended survey question used to determine the UDL familiarity score asked about respondent's attendance at professional development sessions involving UDL. The responses were pre-coded into the following 4 point scale: (0) – zero days, (1) – one to three days, (2) – four to seven days, (3) – eight to ten days, and (4) - more than 10 days of UDL professional development. Table 7 provides the questions and coding for the total familiarity with UDL variable.

Table 7

Total Familiarity with UDL Va	riable: Questions and	Response Coding
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Questions	Familiarity with term UDL (Likert Scale)	What do you think UDL means?* (Open ended question)	What are the three principles of UDL? (Open ended question)	UDL professional development (Open ended question)
Responses:	Strongly Agree (2 points)	Creating instructional change at the planning stage (1 point)	Knows all three principles (3 points)	More than 10 days (4 points)
	Agree (1 point)	Addressing the learning of all students (1 point)	Knows two principles (2 points)	8 – 10 days (3 points)
	Undecided (0 points)	Eliminate the need to modify or alter assignments after initial instruction (1 point)	Knows one principle (1 point)	4 – 7 days (2 points)
	Disagree (-1 point)	Does not know (0 points)	Knows no principles (0 points)	1 – 3 days (1 point)
	Strongly Disagree (-2 points)	No Response (Missing Data)	No Response (Missing Data)	0 days (0 points)

Table 7 (cont'd)

No Response (Missing Data)

Highest Points2334per CategoryNote: Maximum score 12** Responses similar to the coding criteria receive a point

Teacher's self-reported frequency of use of UDL instructional strategies. Likert scale questions regarding the use of instructional strategies that align with UDL principles ("UDL instructional strategies") were developed as frequency questions that provided eight response categories from which to choose. These categories were entered into SPSS using the following values: If there was no response to a question, or the category "Don't know" was selected, the question was assigned a value that indicated that the data was missing, and the response was not included in the data analysis; "Not applicable" was coded as a 0; "a lesson monthly" was coded as a 1; "several lessons a month" was coded as a 2; "a lesson weekly" was coded as a 3; "several lessons a week" was coded as a 4; "a lesson daily" was coded as a 5; and "several lessons daily" was coded as a 6. The mean scores for these quantitative Likert scale frequency questions were between 0 and 6.

Teacher's self-reported frequency of use of technology. Likert scale questions regarding the use of technology were developed as frequency questions that provided eight response categories from which to choose. These categories were entered into SPSS using the following values: If there was no response to a question, or the category "Don't know" was selected, the question was assigned a value that indicated that the data was missing, and the response was not included in the data analysis; "Not applicable" was coded as a 0; "a lesson monthly" was coded as a 1; "several lessons a month" was coded as a 2; "a lesson weekly" was coded as a 3; "several

lessons a week" was coded as a 4; "a lesson daily" was coded as a 5; and "several lessons daily" was coded as a 6. The mean scores for these quantitative Likert scale frequency questions were between 0 and 6.

Development of Independent Variable and Dependent Variables

The data for the dependent and independent variables in this study were aggregated and split based on survey responses into three groups: high, medium, low familiarity with UDL. The split between the groups was somewhat arbitrary. That is, the data relating to a given dependent or independent variable was aggregated so that the number of respondents providing that data were segregated into two or three distinct, but as near as possible equal, sized groupings (e.g., low, medium or high familiarity with UDL). In Chapter 5, the aggregate percentages and an explanation of how the data was apportioned is included for each of the variables.

Development of independent variable for teacher's self-reported familiarity with UDL. Once the teacher's self-reported familiarity with UDL was determined as provided above (i.e., from his or her self-evaluation of his or her familiarity with UDL and the three open-ended survey questions), the UDL familiarity score for all respondents was aggregated into 1 of 3 categories: 1) low familiarity, 2) medium familiarity, or 3) high familiarity. This aggregation was accomplished by using SPSS to compute frequencies on the familiarity scores of all respondents; examining the cumulative percentages of the frequencies; and aggregating the data into the three categories of familiarity listed above so that each cell contained as near to 33% of the respondents' data as possible (i.e., Low 33.9%; Medium 39%; High 28%). It was not possible to aggregate the data using quartile values, as the data did not apportion into those percentiles.

The respondent's level of self-reported familiarity with UDL comprised the most important independent variable of the study.

Development of other independent variables. A second independent variable that related to the teaching experience of participants was developed for this study. The independent variable, number of years teaching was aggregated into 3 categories: 1) 0 - 9 years teaching, 2) 10 - 19 years teaching, and 3) 20 - 33 years teaching. This aggregation was accomplished by using SPSS to compute frequencies on the years of teaching for all respondents; examining the cumulative percentages of the frequencies; and aggregating the data into the three categories of teaching listed above so that each cell contained as near to 33% of the respondents' data as possible (i.e., 0 - 9 years, 32.1%; 10 - 19 years, 35.8%; 20 - 33 years, 32.1%).

A final independent variable was teaching assignment (e.g., general education or special education). The groups for this variable were aggregated based on the respondents' coding of their primary teaching assignment in the survey. Respondents who indicated that they taught general education comprised the general education group (75%) while respondents who indicated they were special education teachers comprised the special education group (25%).

Development of dependent variables for teacher's self-reported frequency of use of UDL instructional strategies. The dependent variable, "Total UDL Principles," was created by combining all of the teacher's self-reported responses to the UDL instructional strategies questions in the survey. The descriptive statistics (frequency) of all of the UDL instructional strategies in the responses were aggregated, using the median (i.e., second quartile), into two categories labeled "low implementation" and "high implementation. This aggregation was accomplished by using SPSS to compute frequencies on the UDL instructional strategies scores of all respondents; examining the cumulative percentages of the frequencies; and aggregating the data into the two categories of implementation frequency listed above so that each cell contained as near to 50% of the respondents as possible (i.e., Low 50%; High 50%).

Each of the individual UDL instructional strategies was categorized by its respective UDL Principle (i.e., UDL Principle 1, 2 or 3) to create the three dependent variables "UDL Principle 1 (Multiple Means of Representation)," "UDL Principle 2 (Multiple Means of Action and Expression)," and "UDL Principle 3 (Multiple Means of Engagement)." The descriptive statistics (frequency) of the UDL instructional strategy in the responses relating to each of the three dependent variables UDL Principle 1, 2, and 3 were aggregated, using the median (i.e., second quartile), into two categories labeled "low implementation" and "high implementation." This aggregation was accomplished by using SPSS to compute frequencies on the UDL instructional strategies scores of all respondents relating to each of the dependent variables (UDL Principle 1, 2 and 3); examining the cumulative percentages of the frequencies; and aggregating the data into the two categories of implementation frequency listed above so that for each of the dependent variables (UDL Principle 1, 2 and 3), each cell contained as near to 50% of the respondents as possible (i.e., UDL Principle 1: Low 51.8%, High 48.2%; UDL Principle 2: Low 53.6%, High 46.4%; UDL Principle 3: Low 50.9%, High 49.1%).

In a further categorization, after each instructional strategy was assigned to one of the three UDL Principles, it was further assigned to one of the components within that UDL principle. For example, an instructional strategy assigned to UDL Principle 1 in the first characterization would then be assigned to one of that UDL Principle's components (i.e., provide multiple examples, stress/highlight critical features, supply multiple media and formats, or support background knowledge). The descriptive statistics (frequency) of the responses for each of the component variables for UDL Principle 1, 2, and 3 were aggregated, using the median (i.e., second quartile), into two categories labeled "low implementation" and "high implementation This aggregation was accomplished by using SPSS to compute frequencies on the UDL instructional strategies

relating to the respective UDL Principle's component scores of all respondents; examining the cumulative percentages of the frequencies; and aggregating the data into the two categories of implementation frequency listed above so that each cell contained as near to 50% of the respondents as possible (see Table 8 for the Low and High for each component of UDL

Principles 1, 2 and 3).

Table 8

Aggregate Percentages for Each UDL Principle 1, 2 and 3 Component: Low High

UDL Principles 1, 2, and 3 Components	Low	High
Principle 1: Multiple means of representation		
Provide multiple examples	51.8%	48.2%
Stress/Highlight critical features	46.4%	53.6%
Supply multiple media and formats	57.1%	42.9%
Support background knowledge	44.6%	55.4%
Principle 2: Multiple means of action and expression		
Supply flexible models of skilled performance	44.6%	55.4%
Provide multiple opportunities to practice with supports	51.8%	48.2%
Provide ongoing, relevant feedback	48.2%	51.8%
Offer flexible opportunities for demonstrating skills	50%	50%
Principle 3: Multiple means of engagement		
Offer choices of content and tools	54.5%	45.5%
Provide adjustable levels of challenge	47.3%	52.72%
Purpose choices of rewards	54.5%	45.5%
Offer choices of learning context	Not used ir	n analysis ¹

¹Due to low alpha this component was not used in data analysis

Development of dependent variable for teacher's self-reported use of technology. The

dependent variable, "Technology," was created by combining all of the technology strategies from the survey. The descriptive statistics (frequency) of the responses were aggregated, using the median (i.e., second quartile), into two categories labeled "low implementation" and "high implementation." This aggregation was accomplished by using SPSS to compute frequencies on the technology scores of all respondents; examining the cumulative percentages of the frequencies; and aggregating the data into the two categories of implementation frequency listed above so that each cell contained as near to 50% of the respondents as possible (i.e., Low 50%; High 50%).

Quantitative Data Analysis

Data was quantitatively analyzed with respect to respondent's answers to questions about their implementation both of instructional strategies that align with UDL practices ("UDL instructional strategies") and of technology designed to support those instructional strategies. These questions include ones such as: which instructional strategies does the respondent use to present lessons (UDL Principle 1); which instructional strategies does the respondent employ to support student action and expression (UDL Principle 2); which instructional strategies does the respondent apply to engage students (UDL Principle 3); and what technology does the respondent utilize to work with students in the classroom.

MANOVA. As set forth below, a number of multivariate analysis of variance (MANOVA) were conducted on various combinations of dependent variables. A MANOVA was used to analyze the data because it allowed the researcher to measure several dependent variables at one time. The advantage to conducting a MANOVA versus separate ANOVAs is that it protects against inflated Type I errors caused by conducting multiple tests of likely correlated dependent variables (i.e., conducting multiple ANOVAs increases the likelihood that something significant could be found by chance) (Tabachnick & Fidell, 2011).

The three dependent variables (i.e., "UDL Principle 1 [Multiple Means of Representation]," "UDL Principle 2 [Multiple Means of Action and Expression]," and "UDL Principle 3 [Multiple Means of Engagement]"), created from the respondents' self-reported

frequency of use of instructional strategies that align with UDL Principle 1, 2, and 3, were used to conduct a MANOVA using SPSS software. The MANOVA was conducted to simultaneously analyze the difference between the differing levels of the independent variable with respect to a linear combination of several dependent variables (Leech et al., 2008). In this case, the researcher was trying to determine if there were statistically significant differences between the levels of teacher self-reported familiarity with UDL (i.e., the independent variable) and a linear combination of teacher self-reported frequency of use of UDL instructional strategies that aligned with UDL Principle 1, 2, and 3 (i.e., the dependent variables). Additionally, if the MANOVA resulted in a finding of significance, the analysis examined if there were statistically significant differences between the levels of self-reported teacher familiarity with UDL and, considered separately, teacher self-reported frequency of use of UDL instructional strategies relating to UDL Principle 1, UDL Principle 2 or UDL Principle 3 (i.e., each Principle is considered as the sole dependent variable) and if so, related to which UDL Principle(s).

To further examine the implementation of the UDL strategies, three MANOVAs were conducted with each MANOVA using the instructional strategies that align with components from one of the three UDL Principles as the dependent variables. This was done to determine if there were statistically significant differences between the levels of teacher self-reported familiarity with UDL (i.e., the independent variable) and a linear combination of teacher selfreported frequency of use of the instructional strategies that align with each of the UDL Principle components (i.e., the dependent variables). For example, with respect to the MANOVA conducted relative to the components of UDL Principle 1, there were four dependent variables, one for each of the four components that comprise UDL principle 1 (i.e., *provide multiple examples*, *stress/highlight critical features*, *supply multiple media and formats*, and *support*

background knowledge). The instructional strategies that align with each component of UDL Principle 1 comprised one of the four dependent variables for that MANOVA.

Additionally, if a MANOVA resulted in a finding of significance, the analysis examined if there were statistically significant differences between the levels of self-reported teacher familiarity with UDL and, considered separately, teacher self-reported frequency of use of the instructional strategies that align with each UDL Principle component. Continuing the forgoing example, if a statistically significance difference was found in the MANOVA relative to UDL Principle 1 components (i.e., *provide multiple examples, stress/highlight critical features, supply multiple media and formats*, and *support background knowledge*), the analysis would have sought to determine which of the four components of UDL Principle 1 (i.e., the group of instructional strategies that align with that component) contributed to the finding of significance.

In addition, MANOVAs were conducted on UDL principles 1, 2, and 3 combined and the UDL Principle components grouped by their corresponding UDL Principle (i.e. Principle 1, Principle 2, or Principle 3), using a second independent variable, namely, years teaching. These analyses were conducted in the same manner as the MANOVAs which used the levels of self-reported teacher familiarity with UDL as the independent variable.

For the levels of self-reported familiarity with UDL and other independent variables assessed (i.e., years teaching) the analyses was conducted in three steps. First, the linear combination of all the self-reported frequency of UDL instructional strategies relating to UDL Principles 1 through 3 were analyzed simultaneously in a multivariate analysis of variance (MANOVA). Second, if the MANOVA was significant the univariate ANOVA results with respect to the self-reported frequency of UDL instructional strategies relating to each of the UDL Principles were examined to determine: (i) the statistical significance of the ANOVA related to

the self-reported frequency of UDL instructional strategies relating to that UDL Principle; and (ii) the statistical significance of the contribution to the overall test of significance arising from the self-reported frequency of UDL instructional strategies relating to that UDL Principle. Third, when significant univariate results were obtained, a post hoc comparison using Tukey's HSD procedure was conducted to determine where significant effects existed. All analyses were conducted using a criterion alpha level of .05.

Crosstabulations. Finally, crosstabulations were conducted on the categorized variables of UDL familiarity (i.e., low, medium, and high), by Total UDL (i.e., low and high) and Technology implementation (i.e., low and high). The purpose of conducting the crosstabulations was to examine the possible relationships between a professed low level of familiarity of UDL with low levels of implementation of the UDL instructional strategies, or when analyzed separately with low levels of implementation of the UDL instructional strategies, or when analyzed separately with high levels of implementation of the UDL instructional strategies, or when analyzed separately with high levels of implementation of the UDL instructional strategies, or when analyzed separately with a low level of implementation of the UDL instructional strategies, or when analyzed separately a low level of implementation of technology, or a professed high level of familiarity of UDL with a high level of implementation of the UDL instructional strategies, or when analyzed separately a low level of implementation of the UDL instructional strategies, or when analyzed separately a high level of implementation of technology, or a professed high level of familiarity of UDL with a high level of implementation of the UDL instructional strategies, or when analyzed separately a low level of implementation of the UDL instructional strategies, or when analyzed separately a high level of implementation of the UDL instructional strategies, or when analyzed separately a high level of implementation of the UDL instructional strategies, or when analyzed separately a high level of implementation of the UDL instructional strategies, or

Crosstabulations were also conducted on the categorized variables of teaching assignment (i.e., general education or special education), by UDL Principle 1, 2, 3, (i.e., low and high), Total UDL (i.e., low and high), and Technology implementation (i.e., low and high). UDL principle components by teaching assignment were also examined. This analysis, rather than a MANOVA, was conducted due to the unequal cell size for this variable (i.e., n = 42 general education; n = 14

special education). Pearson Chi-square tests were used to determine if there was a statistically significant relationship between the categorical variables and either Phi (for 2 x 2 tables) or Cramer's V (for longer tables) tests were used to measure effect size.

Qualitative Data Analysis

Open-ended Survey Questions and Interviews. Responses to open-ended survey questions and interviews were solicited to help the researcher delve more deeply into the specific UDL instructional strategies respondents self-reported implementing relative to each UDL Principle and to technology.

Generation of data for open-ended survey question analysis. The survey respondents were asked to list the top three instructional strategies that they use relative to the following five categories: 1) instruction multiple modalities/senses (e.g., PowerPoint, manipulatives and lecture, activity, lecture, and video clips); 2) multiple media/formats students used to demonstrate learning (e.g., PowerPoint presentation, videos, music, drawing); 3) student choice of content (e.g., book for discussion group, topic to present report on, which mathematics problems they want to solve on a given night [Mon. even problems; Tues. odd problems]); 4) student choice of tools (e.g., word processor, spread sheet, manipulatives, calculators, writing templates, graphic organizers) and 5) software programs to support student learning. In addition, they were asked to code the frequency with which each instructional strategy was implemented. The frequency codes were: several lessons a day (5 points); a lesson daily (4 points); several lessons a week (3 points); a lesson weekly (2 points), and a lesson monthly (1 point).

The responses to the open-ended survey and the frequency questions were entered into Excel documents where the responses were categorized. Once all data was assigned to a category, a count frequency analysis was employed to determine how often a common line of

thinking was reflected in the responses (World Bank, 2007) and the frequency responses were examined to determine how often those strategies were employed. This qualitative data was used to triangulate the results of the quantitative analysis. (See Table 9 for open-ended survey questions.)

Table 9Open-ended Survey Questions Pertaining to the Three UDL Principles

- 1. If you present instruction using 3 or more multiple modalities/senses <u>at least 1 lesson or</u> <u>more per week</u> please list the top 3 multimodal teaching strategies you use (e.g., PowerPoint, manipulative and lecture; activity, lecture, and video clip).
- 2. If you students present their learning using multiple media/formats <u>at least 1 lesson or</u> <u>more per week</u> please list the top 3 ways students to use multiple media/formats (e.g., PowerPoint presentations; videos; music, drawing).
- 3. If you offer students a choice of content <u>at least 1 lesson or more per week</u> please list the top 3 ways you allow students to choose their content (e.g., book for discussion group; topic to present report on; which mathematics problems they want to solve on a given night [Mon. even problems; Tues. odd problems]).
- 4. If you offer students a choice of tools <u>at least 1 lesson or more per week</u> please list the top 3 tools you allow students to choose (e.g., word processor, spread sheet, manipulatives, calculators, writing templates, graphic organizers).

Generation of data for interview analysis. A phone interview was conducted with the three teachers who returned their respective letter of consent. The purpose of the interview was to gain a better perspective into the interviewee's use of Universal Design for Learning in his or her instructional practices. The interview was designed to elicit information as to how the interviewee implemented UDL in his or her instruction (even if the interviewee did not recognize the instruction as UDL) and how they implemented technology to support the implementation or completion of instructional strategies that align with the UDL principles. All interviews were transcribed into Word documents. The data was then examined and coded using UDL principle

1, 2, and 3 instructional strategies within and across all interviews questions. The responses were then used to triangulate data between survey and interview questions.

CHAPTER 5

RESULTS

This section reports the results of the data analysis from the survey and interviews. The analysis addresses the following research questions: 1) What is the type and frequency of teacher self-reported implementation of instructional strategies that align with the UDL principles? 2) What is the teacher's self-reported knowledge of the UDL principles and what is the difference, if any, between that level of self-reported knowledge and the level (considering both type and frequency) of the self-reported implementation of instructional strategies that align with UDL principles? 3) What is the type and frequency of teacher self-reported use of technology for the implementation or completion of instructional strategies that align with the UDL principles?

Data Analysis

Data analysis was conducted using both quantitative and qualitative measures to analyze teacher familiarity of UDL, assess which of the self-reported instructional strategies that align with UDL principles were implemented, and determine the frequency of the implementation of those self-reported instructional strategies. The researcher examined the surveys' open-ended questions to look for themes that appeared in participant responses. Data was analyzed to determine the difference between a teacher's self-reported familiarity with UDL and their self-reported classroom implementation of instructional strategies that align with UDL principles ("UDL instructional strategies"). The researcher looked for several possible outcomes: 1) a professed low level of familiarity of UDL with low levels of self-reported implementation of UDL instructional strategies; 2) a professed low level of familiarity of UDL with a high level of familiarity of UDL with a low level of self-reported implementation of UDL instructional strategies; 3) a professed high level of familiarity of UDL with a low level of self-reported implementation of UDL instructional strategies; 3) a professed high level of

strategies; or 4) a professed high level of familiarity of UDL with a high level of self-reported implementation of UDL instructional strategies.

The teacher's self-reported level of familiarity of UDL was assessed through a Likert-type Scale that allowed them to self-evaluate their familiarity with UDL, and three open-ended survey questions that were coded as quantitative measures. UDL familiarity was then categorized into low, medium, and high familiarity to efficiently analyze the data.

The survey contained a self-rating frequency question for each instructional strategy it assessed (e.g., I present examples to support students' development of patterns and concepts). The type and frequency of the teachers' self-reported implementation of the various instructional strategies that align with the UDL principles was determined by aggregating the individual teacher's responses to those frequency questions. Quantitative analyses were conducted on the Likert scale survey responses to determine if there was any difference between a respondent's self-reported familiarity with Universal Design for Learning and their self-reported implementation of UDL instructional strategies. In addition, qualitative analyses were conducted on survey and interview data to attempt to understand the reasons for the respondents' selfreported implementation of UDL instructional strategies.

Interrater Reliability. Coding (Kent, 2001) for all open-ended survey questions that were used in a quantitative manner underwent interrater reliability. Reliability was computed by dividing the total number of the raters' agreements (both coded and uncoded) by the total codes possible. The raters independently looked at the short answer responses to "what do you think UDL means" and "what are the 3 principles of UDL." and independently assigned a point value to each response. The researcher then compared the tables and found 3 areas of disagreement for the question "what do you think UDL means." Interrater reliability for that question was 92.1%

(35/38 agreements). The raters then came to a consensus about how to code the data and the codes were changed accordingly. Interrater agreement was 100% for the question "what are the 3 principles of UDL.

Exploratory Analysis

SPSS software was used to code and analyze the quantitative survey data. An exploratory data analysis (EDA) was conducted to examine data to look for potential problems and make corrections before conducting statistical analysis (Leech et al., 2008). The EDA of the SPSS survey data revealed that all data were coded correctly. All instructional strategy and technology Likert scale questions were within the required means (i.e., 0 to 6). Additionally, the Likert scale question asking respondents to self-rate their familiarity with UDL was within the -2 to 2 range.

Assumptions and Reliability

Assumptions. Descriptive statistics on UDL instructional strategies for Principle 1, 2, and 3, and Technology variables, aggregated by low and high levels, were conducted to examine cell sizes and it was determined both that all cells were equal or nearly equal in size and that unequal cells were within a 1:1.5 ratio. The use of equal or nearly equal cell sizes (1:1.5 ratio) was utilized to compensate for any potential issues with multivariate normality or homogeneity of variance/covariance (Leech et al., 2008). Additionally, for each MANOVA that was conducted, a Box's M test and Levene's statistic were calculated and examined for issues with homogeneity of variance/covariance (Leech et al., 2008). The assumptions of independence of observations and homogeneity of variance/covariance were both checked and were both satisfied for the UDL Principle 1, 2, and 3 variables and their corresponding components.

A Pearson Correlation was conducted to determine if the dependent variables (i.e., UDL instructional strategies for Principle 1, 2, and 3) were moderately correlated (collinearity) and to

assess whether multicollinearity existed between pairs of dependent variables. The correlations for UDL instructional strategies for Principles 1 and 2 and Principles 1 and 3 were moderately correlated at r = .455 and r = .418 respectively. The correlation for UDL instructional strategies for Principles 2 and 3 were correlated at the r = .601 level. These levels verify that multicollinearity is not present (Faul, Erdfelder, Buchner, & Lang, 2008).

Reliability. Cronbach's Alpha was computed using SPSS to assess the internal consistency of groups of items in the research survey (Gersten et al., 2005; Leech et al., 2008). Gersten et al., recommends coefficient alpha reliabilities of at least .60. The 38 items that were summed to create the Total UDL Principles scale had an alpha of .94. This indicates that the items form a scale with good internal consistency. Additionally, separate scales were created for UDL instructional strategies for Principle 1 (14 items), UDL instructional strategies for Principle 2 (12 items), UDL instructional strategies for Principle 3 (12 items), and Technology (13 items). The alpha for the UDL instructional strategies for Principle 1 scale was .82, which indicates good internal consistency reliability. The alpha for the UDL instructional strategies for Principle 2 scale (.87) and for Principle 3 scale (.89) also indicated good internal consistency reliability, while the alpha for the Technology scale (.78) indicated reasonable internal consistency.

Cronbach's Alpha for the UDL instructional strategies underlying the individual components of UDL Principles 1, 2, and 3 were also calculated. All three of the UDL principles were comprised of 4 components (i.e., 12 components total) with 2 to 4 instructional strategies underlying each component (e.g., UDL Principle 1 component *Stress/highlight critical features*, was supported by the following instructional strategies: *Supports [e.g., graphic organizers] for key features*; *Prompts and cues to recognize critical features*; and *Connection between types of information [e.g., text/charts*]). When the alphas were calculated for two of the components,

Support background knowledge a component of UDL Principle 1; and Choices of rewards a component of UDL 3, the researcher found that not all of the instructional strategies underlying those components had a high enough correlation to be included in the summated rating scale of said components. Therefore, an instructional strategy was removed from each component prior to computing its alpha. The instructional strategy, *Provide key instructional materials in students' first language*, was removed from the component *Support background knowledge*, and the instructional strategy, *Provide students with grade guidelines*, was removed from the component *Choices of rewards*.

Additionally, the researcher found that the Cronbach's Alpha for the UDL principle 3 component, *Offer choices of learning context*, did not have a high enough internal consistency to be used in the data analysis. The alpha for that component was .46. The alphas for the 11 remaining components ranged from .61 indicating that the items formed a scale with minimally adequate internal consistency reliability to .80 indicating good internal consistency. (See Table 10 for the alpha for each component of UDL principle 1, 2, and 3.)

Table 10

Cronbach's Alpha for Universal Design for Learning Principle 1, 2, and 3 Components

UDL Principles 1, 2, and 3 Components	Alpha	
Principle 1: Multiple means of representation		
Provide multiple examples	.63	
Stress/Highlight critical features	.75	
Supply multiple media and formats	.76	
Support background knowledge	.80	
Principle 2: Multiple means of action and expression		
Supply flexible models of skilled performance	.70	
Provide multiple opportunities to practice with supports	.65	
Provide ongoing, relevant feedback	.75	
Offer flexible opportunities for demonstrating skills	.67	

Table 10 (cont'd)

Principle 3: Multiple means of engagement	
Offer choices of content and tools	.80
Provide adjustable levels of challenge	.64
Purpose choices of rewards	.61
Offer choices of learning context	.46 ¹

^TDue to low alpha this component was not used in data analysis

Findings

Quantitative Analysis

There were 57 respondents who completed a survey for this study. However, only 56 of the surveys were used for data analysis purposes. The survey that was excluded was determined by the researcher to be incomplete (i.e., 27 of the 87questions [31%] were unanswered) and therefore necessarily excluded.

Survey participant descriptive statistics. The 56 respondents consisted of 14 special education teachers (25%) and 42 general education teachers (75%). Nine of the respondents were male (24.5%) and 47 were female (75.4%).

There were 22 teachers (40.7%; i.e. 22/54) assigned to an individual grade level from kindergarten through twelfth grade while 32 teachers (59.2%) were assigned to teach more than one grade level. Fifteen of the 32 teachers who reported that they taught multiple grades were teaching in split-level (multi-grade) classrooms. Two teachers did not identify their instructional levels and therefore were not included in the denominator used in the percentage calculations contained in this paragraph. The grade level teaching assignments of the responding teachers were parsed as follows: 23 elementary school teachers (42.6%) (i.e., assigned to one or more grades Kindergarten through fifth), 11 middle school teachers (20.4%) (i.e., assigned to one or more

grades nine through twelve), 1 teacher (1.9%) who taught in the elementary and middle school, 1 teacher (1.9%) who taught in the elementary and high school, 1 teacher (1.9%) who taught at the elementary, middle and high school levels, and 2 teachers (3.7%) who taught at both the middle and high school levels. As previously noted, 2 teachers did not identify the grade levels at which they taught.

Survey participants varied widely with respect to the number of years of teaching experience. Participant's teaching experience ranged from less than 1 year to 33 years. The median number of years taught was 14.5 years and the average was 13.9 years of teaching.

The highest number of respondents (26 teachers, or 47.3%; i.e. 26/55) had their Master of Arts in teaching, while 13 teachers (23.6%) had their Masters plus additional credits. There were 13 teachers (23.6%) whose highest degree was their Bachelor of Arts or Science degree. One teacher (1.8%) had earned a Doctors of Philosophy, and 2 teachers (3.6%) had earned an Education Specialist degree. One respondent did not indicate the level of his/her teaching degree and was not included in the denominator used in the percentage calculations contained in this paragraph.

The number of instructional preparations for teachers who participated in this survey ranged from 0 preparations to 12 preparations per day. There were 13 teachers (23.2%; i.e., 13/54) who had 5 preparations per day and 1 teacher (1.8%) who had 12 preparations each day. The median number of preparations was 4, the mean was 3.89 preparations and the mode was 5 preparations. One teacher did not respond to the question and another was not specific about the number of preps he/she had so neither were included in the denominator used in the percentage calculations contained in this paragraph.

Interview participant descriptive statistics. The 3 interview participants consisted of 2 special education teachers (66.6%) and 1 general education teachers (33.3%). However, the general education teacher's major was special education. One of the interviewees was male (33.3%) and 2 were female (66.6%).

There was one elementary school teacher (33.3%), one middle school teacher (33.3%), and one teacher who taught at the middle and high school levels (33.3%). The three interviewees taught 12 years, 16 years, and 30 years respectively.

UDL descriptive analysis. An item level descriptive analysis was conducted to determine the mean and standard deviation for each UDL instructional strategy. This analysis allowed the researcher to assess and report on the self-reported frequency with which each individual UDL instructional strategy was implemented in the classroom. An item level descriptive analysis was also conducted to examine which UDL components respondents used most often in their instruction.

Instructional strategies to support representation: UDL principle 1. UDL Principle 1 refers to teachers providing multiple means of representing information during instruction. Data for this category was provided by the 14 frequency questions from the survey that comprised the instructional strategies underlying UDL Principle 1. None of these 14 frequency questions had quantifiable responses provided by less than 52 responses to the survey; the range of responses to the survey that provided quantifiable responses to these questions ranged between 52 and 56. The percentages reported below, relative to each frequency question, were calculated using, as the denominator, the total number of quantifiable responses provided for that question. *Provide prompts and cues to recognize critical features of concepts* and *present examples to support students' development of patterns and concepts* yielded the highest mean scores at 5.36 and 5.09

respectively. For both questions the majority of respondents (38/55; 69% and 30/55; 54.5% respectively) coded that they used these UDL instructional strategies in "several lessons a day." One additional question, *help students make connections between information provided in text and other forms of that information (e.g., illustrations, charts, or diagrams)* had a mean of 5.02 with 30 (out of 56) respondents coding that they use this strategy in "several lessons a day." Survey results suggest that the respondents implemented these three UDL instructional strategies most often during the presentation of instructional materials.

The question regarding *provide key instructional materials in student's first language* had a mean score of 1.53. Thirty-five of the respondents (62.5%) coded that translation was "not applicable" to their instruction. A second question, *provide auditory media (e.g., Digital, MP3, CDs of textbooks, books on tape, e-text read with text reader) to introduce concepts during instruction*, had a mean score of 3.00. The largest number of the 54 respondents coded that they provided this strategy either "several lessons a week" (14/54; 25%) or that it was "not applicable" (10/54; 17.9%) to their instruction. The scores of these two questions signify that respondents used these instructional strategies least when providing multiple means of representation during the presentation of instructional materials. Means and standard deviations are provided in Table 11 for all 14 UDL Principle 1 instructional strategies.

Table 11

UDL Principle 1: Multiple Means of Representation Components with Instructional Strategies Means

UDL Principle 1: Components and Instructional Strategies	Mean	SD
Provide multiple examples:		
Examples of patterns/concepts	5.09	1.22
Non-examples of patterns/concepts	4.02	1.94
Present materials using two modalities	4.52	1.77
Present materials using three or more modalities	3.95	1.78

Table 11 (cont'd)

Stress/Highlight critical features:		
Supports (e.g., graphic organizers) for key features	4.61	1.41
Prompts and cues to recognize critical features	5.36	1.19
Connection between types of information (e.g., text/charts)	5.02	1.33
Supply multiple media and formats:		
Varied instructional materials	4.84	1.55
Multiple print formats	3.31	2.06
Auditory media (e.g., tapes, CDs of textbooks)	3.00	2.00
Visual media (e.g., DVD, video clip)	3.33	1.68
Support background knowledge:		
Connect learning to what students already know	4.58	1.58
Teach background information (e.g., define vocabulary)	4.73	1.16
Instructional materials in student's first language	1.53	2.33

Instructional strategies to support student action and expression: UDL principle 2. UDL

Principle 2 refers to the teacher providing students with multiple means of action and expression to demonstrate their learning. Data for this category was provided by the 12 frequency questions from the survey that comprised the instructional strategies underlying UDL Principle 2. None of these 12 frequency questions had quantifiable responses provided by less than 52 of the survey respondents and the range of responses was between 52 and 56. The percentages reported below, relative to each frequency question, were calculated using the total number of quantifiable responses provided for that question as the denominator. The UDL instructional strategies *frequent ongoing feedback in multiple formats* and *provide process models to guide student's work* were the questions that yielded the highest mean scores at 4.38 and 4.26 respectively. For *frequent ongoing feedback in multiple formats* 20 respondents (20/56, 35.7%) coded that they used this UDL instructional strategy for "several lessons a day" and an additional 17 respondents (17/56 30.4%) coded that they used this strategy for "several lessons a week." For the instructional strategy, *provide process models to guide student's work*, 17 respondents (17/54,

31.5%) coded that they used this strategy to support student learning for "several lessons daily." An additional, 21 respondents coded that they either used this strategy for "a lesson daily" (11/54; 20.4%) or for "several lessons a week" (10/54; 18.5%). This data suggests that the respondents in the survey used these two instructional strategies most often to support student action and expression.

The UDL instructional strategies with the lowest mean scores were *sharing student* learning/products beyond the classroom (2.23), create assignments or assessments that provide students the opportunity to use multiple media/formats to demonstrate knowledge (2.83), and provide students with guides for breaking long-term projects into achievable steps (2.93). For the instructional strategy, sharing student learning/products beyond the classroom, 32.7% of the respondents (17/52) coded that this strategy was used for "a lesson monthly" while an additional 8 respondents (15.4%) coded that this strategy was "not applicable" to their instruction. For the instructional strategy, create assignments or assessments that provide students the opportunity to use multiple media/formats to demonstrate knowledge the responses were varied. Twelve respondents (22.2%, 12/54) coded that they used this strategy for "several lessons a month" while 6 others (11.1%) felt it was "not applicable" to their instruction. However, 10 respondents (18.5%) coded that they used this instructional strategy for "several lessons a week." For the instructional strategy, provide students with guides for breaking long-term projects into achievable steps, 12 respondents (12/56; 21.4%) felt that this strategy was "not applicable" to their instruction while 9 others (16.1%) coded that they used the strategy "several lesson a month."

The mean scores of these UDL instructional strategies signify that respondents used these instructional strategies least when providing multiple means of action and expression for their

students. Additionally, the overall data suggests that the majority of participants implemented these instructional strategies for several lessons weekly or less with many respondents coding that the strategies were not applicable to their instruction.

Two other UDL instructional strategies, *provide opportunities for student to self-monitor work completion*, and, *provide items to structure* work, had mean scores of 3.30 and 3.05 respectively. While these instructional strategies did not have the lowest means they merit mention. Analysis of the breakdown of the responses for these instructional strategies suggests a discrepancy in the respondent's value of the implementation of these strategies. The two highest response codes for both strategies were "not applicable" with 13 (13/54, 24.1%; and 13/55, 23.6% respectively) responses each while the second highest response code was "several lessons a day" with 13 (13/54, 24.1%) and 12 (12/55, 21.8%) responses respectively. Means and

standard deviations are provided in Table 12 for all 12 UDL Principle 2 instructional strategies.

Table 12

UDL Principle 2: Multiple Means	s of Action and	d Expression	Components with	Instructional
Strategies: Means				

UDL Principle 2: Components and Instructional Strategies		SD	
Supply flexible models of skilled performance:			
Product model (e.g., example of finished product)	3.51	1.74	
Process model (e.g., steps in pre-writing)	4.26	1.72	
Supply different models for reaching goals	3.78	1.98	
Provide multiple opportunities to practice with supports:			
Provide items to structure work	3.05	2.24	
Use scaffolds to support learning goals (e.g., spell check)	3.39	2.23	
Provide ongoing, relevant feedback:			
Provide guides (e.g., rubrics) to evaluate quality of work	3.33	1.86	
Provide calendars, timelines to guide work completion	2.93	2.24	
Student self-monitor work completion	3.30	2.35	
On-going feedback in multiple formats	4.38	1.58	
Offer flexible opportunities for demonstrating skills:			
Student learning shared beyond classroom	2.23	1.86	

Table 12 (cont'd)

Supports to express/explains answers	3.89	2.03
Multimedia to demonstrate knowledge	2.83	1.89

Instructional strategies to support student engagement: UDL principle 3. UDL Principle 3 refers to increasing student engagement by providing students the choice of content, methods, and materials whenever possible. Data for this category was provided by the 12 frequency questions from the survey that comprise the UDL instructional strategies underlying UDL Principle 3. None of these 12 frequency questions had quantifiable responses provided by less than 52 responses to the survey; the range of responses to the survey that provided quantifiable responses to these frequency questions was between 52 and 55. The percentages reported below, relative to each frequency question, were calculated using the total number of quantifiable responses provided for that question as the denominator. The UDL instructional strategies provide individualized feedback to support student learning, provide students with opportunities to share and demonstrate their learning, and provide varying levels of challenge for students had mean scores of 4.49, 4.45, and 4.31 respectively. All three instructional strategies had the highest number of respondents coding this strategy as being used for "several lessons a day" (22/55, 40%; 22/55, 40%; and 20/54, 37% respectively). The results suggest that these instructional strategies are used most often by the survey respondents to support student engagement during instruction.

The UDL instructional strategies *student choice of options for feedback* (1.13), *allow students choice of content for an assignment* (1.82), *provides students with their choice of rewards or recognitions when reaching academic* goals (1.85), and *allow students choice of tools to complete assignments* (1.91) have the lowest mean scores for this category. Respondents overwhelmingly coded (31/52; 59.6%) that the instructional strategy *student choice of options*

for feedback was "not applicable" to their instruction. The other three instructional strategies were also predominantly coded as "not applicable" with 22 responses (22/55; 40%) for *allow students choice of content for an assignment*, 24 responses (24/52; 46.2%) for *provide students with their choice of rewards or recognitions when reaching academic goals*, and 21 responses

(21/55; 38.2%) for allow students choice of tools to complete assignments. Means and standard

deviations are provided in Table 13 for all 12 UDL Principle 3 instructional strategies.

Table 13

UDL Principle 3: Multiple Means of Engagement Components with Instructional Strategies Means

Offer choices of content and tools	
Student choice of content (e.g. book to read; report topic) 1.82	2.09
Student choice of tools (e.g., word processor or write by hand) 1.91	2.04
Relate task to student interest 3.91	1.83
Choice of activities to demonstrate learning 2.69	1.92
Provide adjustable levels of challenge	
Provide varying levels of challenge for assignments 4.31	1.90
Students choose resources to use as needed3.19	2.38
Propose choices of rewards	
Students allowed choice of rewards for accomplishing goals 1.85	2.24
Provide individualized feedback to support student learning 4.49	1.67
Provide grade guidelines 2.11	2.08
Students have opportunities to demonstrate learning 4.45	1.67
Offer choices of learning context	
Choice of flexible work groups (e.g. pairs, small group) 3.74	1.86
Options for feedback 1.13	1.79

UDL principle components. The mean score for a given UDL component was calculated

by aggregating the mean score of the instructional strategies that align with that component. The

mean scores of the UDL components were calculated to illuminate any implementation

differences within the components of any one of the UDL principles and between the components of all three UDL principles.

The mean scores revealed that the instructional strategies that were implemented most often by the respondents to this survey were from UDL Principle 1. The instructional strategies underlying the component *stress highlight critical features* had a mean score of 5.00, those underlying the component *support background knowledge* had a mean score of 4.88, and those underlying the component, *provide multiple examples* had a mean score of 4.39. These were the only components that had instructional strategies with a mean of 4 or higher. The components, *supply flexible models of skilled performance*, from UDL Principle 2, *adjust level of challenge* from UDL Principle 3, and *supply multiple media and formats* from UDL Principle 1 had the next highest means at 3.79, 3.72, and 3.65 respectively. However, these components had a median scores of 4.0 which means that half the respondents implemented the instructional strategies underlying these components for "several lessons a week" or less and half of the respondents implemented the instructional strategies underlying these components for "several lessons a week" or more.

The least implemented components were from UDL Principle 3 and UDL Principle 2. The component, *offer choices of content and tools*, from UDL Principle 3 had a mean score of 2.48 while the component, *offer flexible opportunities for demonstrating* skills, from UDL Principle 2 had a mean score of 2.57. The results suggest that survey participants implemented the instructional strategies underlying these components least often in their classrooms. Mean and standard deviations for the UDL components from all three principles can be found in Table 14.

Table 14

Universal Design for Learning Principle 1, 2, and 3 Component (All Instructional Strategies Included): Means

UDL Principle 1, 2, and 3 Components	Mean	SD
Principle 1: Multiple means of representation		
Drovido multiple acomples	4.20	1 16
Provide multiple examples	4.39	1.10
Stress/Highlight critical features	5.00	1.07
Supply multiple media and formats	3.65	1.37
Support background knowledge	4.88	1.01
Principle 2: Multiple means of action and expression		
Supply flexible models of skilled performance	3.79	1.50
Provide multiple opportunities to practice with supports	3.51	1.69
Provide ongoing, relevant feedback	3.51	1.57
Offer flexible opportunities for demonstrating skills	2.97	1.52
Principle 3: Multiple means of engagement		
Offer choices of content and tools	2.57	1.57
Provide adjustable levels of challenge	3.72	1.88
Purpose choices of rewards	3.63	1.42
Offer choices of learning context	Not used	in analysis ¹

¹Alpha was .44 meaning that the underlying strategies did not form a reliable component

Technology descriptive analysis. Technology is used in the UDL environment to create flexibility in the curricula which allows students to overcome the barriers that they may face during instruction. Data for this category was provided by the 13 frequency questions from the survey that related to various technologies. None of these 13 frequency questions had quantifiable responses provided by less than 44 responses to the survey; the range of responses to the survey that provided quantifiable responses to these questions was between 44 and 54. The percentages reported below, relative to each frequency question, were calculated using the total number of quantifiable responses provided for that question as the denominator.

Overall, technology did not appear to be used to a significant degree by the respondents in this survey. Word processing programs had a mean of 2.07 and it was the only technology that had a mean above 2.0. The majority of respondents coded this question into one of three categories. Fourteen of the respondents (14/54, 25.9%) coded that student use of a word processing program was "not applicable" to their instruction; 13 respondents (24.1%) coded that students used this technology for "several lessons a month;" and 11 of the respondents (20.4%) coded that students used this technology for "several lessons a week." Two other technologies were near the 2.0 mean. The first, use of video streaming to present concepts had a mean score of 1.89, and the second, use of *websites to present instruction* had a mean score of 1.87. Fourteen respondents coded that they used video streaming to present concepts in "a lesson monthly" (14/54, 25.9%) while 12 (22.2%) felt that this technology was "not applicable" to their instruction. The coding for use of *websites to present instruction* revealed that 15 respondents (15/53, 28.3%) felt that this technology was "not applicable" to their instruction, while 11 respondents (11/53, 20.8%) coded that they used websites to present instruction for "a lesson monthly" and 11 others (11/53, 20.8%) coded that they used this technology for "several lessons" a month."

When examining the survey responses, 5 of the 13 technology items were coded as being used in the classroom for "several lessons a day," and 5 were coded as being used for "a lesson daily." Technologies that were coded as being used for both "several lessons a day" and "a lesson daily" included *word processing programs* which 2 respondents (2/54, 3.7%) coded as being used in "several lessons and day" and 1 respondent (1/54, 1.9%) coded as being used by students for "a lesson daily." Three other technologies were coded as being used in both categories. They were *websites to present instruction* (3 respondents [3/53, 5.7%] coded "several

lessons a day" and 1 respondent [1/53, 1.9%] coded "a lesson daily"), *video streaming to present concepts* (1 respondent [1/54, 1.9%] coded "several lessons a day" and 2 respondents [2/54, 3.7%] coded "a lesson daily"), and *computer software programs* (1 respondent [1/54, 1.9%] coded "several lessons a day" and 3 respondents [3/54, 5.6%] coded "a lesson daily"). An additional technology that was coded as being used for "several lessons a day" was *e-books* with 1 response (1/40, 2.0%) coded in that category. A technology that was coded as being used for "a lesson daily" was *student use of writing template software* with 1 response (1/46, 2.2%). Means and standard deviations are provided in Table 15 for all 13 technologies.

Open-ended Survey Questions

Open-ended survey questions were asked to help the researcher delve deeper into aspects of the implementation of specific UDL strategies and technology. If respondents coded that they implemented the specific instructional strategies or technology that corresponded with the open-ended survey question (e.g., multiple means of modality) "at least 1 lesson or more per week," they were asked to respond to short answer questions about those responses and enter a frequency code for how often they implemented each strategy.

The responses were categorized for each question. Once categorized a count frequency analysis was employed to determine how often a line of thinking occurred between respondents (World Bank, 2007) and the frequency count was examined to determine how often a category was implemented (e.g., a lesson monthly, a lesson weekly, several lessons a week). The results were then used to corroborate the quantitative survey findings of the frequency questions where applicable.

UDL open-ended survey questions. The survey respondents who coded that they implemented specific instructional strategies "at least 1 lesson or more per week" were asked to
list the top three instructional strategies in the following areas: 1) multiple modalities/senses; 2) multiple media/formats students used to demonstrate learning; 3) student choice of content; and 4) student choice of tools. It was also requested that they code the frequency of the implementation for the strategies they listed.

Multimodal teaching strategies. For the question, "If you present instruction using 3 or more multiple modalities/senses <u>at least 1 lesson or more per week</u>, please list the top 3 multimodal teaching strategies you use" the researcher analyzed data from 38 (67.9%) of the 56 respondents. The 38 respondents whose data was analyzed provided a total of 84 valid responses that were categorized for this analysis. There were 10 non-responders (17.9%) for this question and 8 respondents (14.3%) who did not give enough information (e.g., activity, auditory, math, visual, kinesthetic) for the researcher to reliably categorize their responses. The percentages reported below, relative to this open-ended survey question, were calculated using the total number of valid responses (84) as the denominator.

The predominant instructional strategy for implementing multimodal instruction was *video* paired with other instructional practices. Twenty-one respondents (21/56; 55.2%) wrote down *video* as one of their multimodal instructional strategies. *Video* paired with *PowerPoint* (8 responses; 8/84, 9.5%) was the top multimodal practice for respondents who used *video* in this survey. The other top multimodal practices in this category, with 6 responses (7.1%) each, were *video* with *manipulatives* and *video* with *lectures*.

Use of *manipulatives* was the second highest instructional strategy for this question with 16 responses (19%). *Manipulatives* were paired most often with *video* (6 responses; 7.1%), and with *lecture* (4 responses; 4.76%).

The third highest multimodal instructional strategy with 15 responses (17.9%) was *PowerPoint*. As stated earlier, *PowerPoint* paired with *video* received 8 responses (9.5%) and was the highest multimodal practice for this category as well. *PowerPoint* was also paired with *manipulatives* (3 responses; 3.6%) and *lecture* (2 responses; 2.4%).

While *video* was the predominant instructional strategy respondents mentioned in the open-ended multimodal survey question, according to the overall frequency coding (2.57) this strategy was implemented by respondents between "a lesson weekly" and "several lessons a week." This corresponded with the response breakdown for the instructional strategy survey frequency question, *provide visual media to introduce concepts*, with the majority of respondents coding that they implemented this strategy "a lesson weekly" (12/55 respondents; 21.8%) or for "several lessons a week" (18/55 respondents; 32.7%).

Student use of multimedia. For the question, "If your students present their learning using multiple media/formats <u>at least 1 lesson or more per week</u>, please list the top 3 ways students use multiple media/formats" the researcher analyzed data from 25 (44.6%) of the 56 respondents. The 25 respondents whose data was analyzed provided a total of 67 valid responses that were categorized for this analysis. There were 31 non-responders (55.4%) for this question. The percentages reported below, relative to this open-ended survey question, were calculated using, as the denominator, the total number of responses (67).

The predominant strategy for multimedia instructional strategies offered to students was *drawing* with 12 responses (12/67; 17.9%). The use of *PowerPoint* to demonstrate student learning was the second highest multimodal strategy recorded with 11 responses (16.4%) and *writing* (e.g., email, friendly letter, research reports) was the third highest multimodal strategy with 9 responses (13.4%).

As stated, *drawing* was the predominant instructional strategy listed for multimedia that students use to demonstrate learning. According to the overall frequency coding, *drawing* (3.17) was implemented by these respondents for "several lessons a week." This was slightly above the response breakdown for the instructional strategy survey frequency question, *use multiple media/formats to demonstrate knowledge*, with the overall respondents coding (2.83) that they implemented this strategy for almost "a lesson weekly." However, when looking at the overall coding for both *PowerPoint* (2.01) and *writing* (1.91) the respondents coded that they implement these strategies for approximately "a lesson weekly" which corresponds with the respondents' coding for the instructional strategy frequency question, *use multiple media/formats to demonstrate knowledge*.

Choice of content. For the question, "If you offer students a choice of content <u>at least 1</u> lesson or more per week, please list the top 3 ways you allow students to choose their content" the researcher analyzed data from 15 (26.8%) of the 56 respondents. The 15 respondents whose data was analyzed provided a total of 31 valid responses that were categorized for this analysis. There were 40 non-responders (71.4%) for this question and 1 respondent (1.8%) who did not give enough information (i.e., N/A) for the researcher to categorize his/her responses. The percentages reported below, relative to this open-ended survey question, were calculated using the total number of valid responses (31) as the denominator.

The predominant instructional strategy for student choice of content was *reading materials* (*e.g., book to read, book for guided reading, literature circle book*) with 15 responses (15/31; 48.4%) listed. Allowing student choice of *writing topics* was the second highest instructional strategy recorded with 6 responses (19.4%) and choice of *math problems* (i.e., independent work, math review, math problems) was the third highest instructional strategy for choice of content with 4 respondents (12.9%) referencing that strategy.

When examining the overall frequency coding for allowing students choice of content respondents coded choice of *math problems* (3.75) as being implemented for almost "a lesson daily." *Reading materials* (3.0) were coded as being implemented for "several lessons a week," and choice of *writing topics* (2.33) was coded as being implemented between "a lesson weekly" and "several lessons a week."

Interestingly, the short-answer question, *offer students a choice of content*, had the lowest number of respondents (15/56; 26.8%) for any of the UDL open-ended survey questions. Likewise, the instructional strategy frequency question that corresponded with this open-ended question, *allow students choice of content for an assignment*, had the highest number of respondents (22/55; 40%) who coded that this strategy was "not applicable" to their instruction, or that they implemented this strategy for "a lesson monthly" (12; 21.8%). While this signifies that the majority of respondents (61.8%) did not implement this instructional strategy or implemented it sparingly, the next highest response code for the instructional strategy frequency question, *allow students choice of content for an assignment*, was "a lesson daily" (6; 10.9%). The last response category (i.e., "a lesson daily) was similar to the implementation for student choice of *math problems*, which makes sense because respondents from the aforementioned categories (i.e., "not applicable" and "a lesson monthly") would not have been asked to respond to this open-ended question.

Choice of tools. For the question, "If you offer students a choice of tools <u>at least 1 lesson</u> <u>or more per week</u>, please list the top 3 tools you allow students to choose" the researcher analyzed data from 18 (32.1%) of the 56 respondents. The 18 respondents whose data was

analyzed provided a total of 40 valid responses that were categorized for this analysis. There were 37 non-responders (66.1%) for this question and 1 respondent (1.8%) who did not give enough information (i.e., we vary tools) for the researcher to categorize his/her responses. The percentages reported below, relative to this open-ended survey question, were calculated using the total number of valid responses (40) as the denominator.

The predominant tool for student choice with 10 responses (10/40; 25%) was *word processing*. Allowing student choice of *manipulatives* was the second highest tool with 8 responses (20%) and *graphic organizers* was the third highest tool with 7 responses (17.5%). Student choice of *writing templates* was the fourth highest tool respondents listed with 6 responses (15%).

The overall frequency with which the aforementioned tools were available for student choice ranged between "several lessons a week" and "several lessons a day" (*word processing*, 3.20; *graphic organizers*, 3.29; and *manipulatives*, 3.63). Interestingly, drawing had only 2 responses for this open-ended question as a tool that students can choose to use, but it was the predominant instructional strategy mentioned for the open-ended question, *students present their learning using multiple media/formats*. This suggests that while the respondents in this survey allowed students to use *drawing* as a tool to present their learning, it was allowed by teacher discretion rather than being available as a tool from which students could choose.

Another tool that was mentioned as being available for student choice was *graphic organizers*. However this tool was only mentioned once as a strategy in the open-ended question, *students present their learning using multiple media/formats,* and it was not listed at all for the open-ended question about multimodal instruction. This suggests that students can use this tool

to support their understanding of a topic but that it is not being used as a means for students to demonstrate what they have learned.

Technology open-ended survey question. The survey contained one open-ended survey question where the survey respondents who coded that they implemented software programs to support student learning "at least 1 lesson or more per week," were asked to list the top three technologies they use.

Computer software programs. For the question, "If you use computer software programs to support student learning <u>at least 1 lesson or more per week</u>, please list the top 3 programs you use" the researcher analyzed data from 12 (21.4%) of the 56 respondents. The 12 respondents whose data was analyzed provided a total of 26 valid responses that were categorized for this analysis. There were 44 non-responders (78.6%) for this question. The percentages reported below, relative to this open-ended survey question, were calculated using the total number of valid responses (26) as the denominator.

The predominant categories for software to support student learning were *word* processing and math software with 3 responses (11.5%) each. Allowing students to use PowerPoint and Compass Learning were the second highest software recorded with 2 responses, (7.7%) each.

According to the overall frequency coding, *word processing* (2.67) was implemented by these respondents between "a lesson weekly" and "several lessons a week." This was slightly above the overall code for the instructional strategy survey frequency question, *word processing program*, with the respondents coding that they implemented this strategy for "several lessons a month."

UDL Familiarity Component Development

The data used to compute the UDL Familiarity for each respondent consisted of a Likert Scale question (i.e., Rate your familiarity with UDL) and three open-ended survey questions (i.e., What do you think UDL means? What are the 3 principles of UDL? How much UDL professional development have you attended?). The open-ended survey questions were qualitatively analyzed and a quantitative value was given to each respondents answer based on specific criteria set forth in Table 7. Using the SPSS transform and compute variable function, the researcher calculated the mean score of the three open-ended survey questions, and one 5 point Likert scale question, to create a composite variable called *total familiarity with UDL*.

Self-evaluation of familiarity with UDL. The respondents were asked to rate (between Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree) if they were "familiar with the term Universal Design for Learning." This question was coded on a 5 point scale from -2 - strongly disagree to 2 – strongly agree. All 56 of the respondents answered this question.

Most respondents, 23 or 41.1%, were undecided when rating whether they were familiar with the term UDL. Eleven respondents (19.6%) agreed with the statement that they were familiar with the term, while 4 respondents (7.1%) stated that they strongly agreed that they were familiar with the term UDL. The remaining 18 respondents coded that they disagreed (10 respondents; 17.9%) or strongly disagreed (8 respondents; 14.3%) with the statement that they were familiar with the term UDL.

Meaning of UDL. The open-ended survey question, "What do you think UDL means?" was coded (Kent, 2001) into a quantitative 4 point scale (i.e., *does not know, low familiarity, some familiarity, high familiarity*) based on the respondent's written reply. Respondent's scores ranged from 0 to 3 points based on the similarity of their written responses to predetermined coding

categories (refer to table 7). There were 38 respondents (67.9%) who answered this question and 18 non-responders (32.1%). The percentages reported below were calculated using the total number of respondents (38) who provided an answer for this question as the denominator.

The 38 respondents were parsed into the following categories: (0) do not know, 14 respondents or 36.8%; (1) low familiarity, 15 respondents or 39.5%; (2) some familiarity, 9 respondents or 23.7%; and (3) high familiarity, none of the respondents were included in this category as none received 3 points.

Responses in the "do not know" category were, "I can assume it has something to do with the one best way for learning" or "A standard lesson plan." While the "low familiarity" category had responses such as, "strategies and tools to ensure learning for all" or "…incorporate a variety of strategies to reach all students." The some familiarity category responses were, "creating and using curriculum that supports all learners giving each student an equal chance at learning," or "designing learning opportunities that will provide access to materials/curriculum for ALL students…" Interrater reliability for this measure was 94.7%. The raters agreed on 108 out of 114 total codes (31 assigned codes and 83 unassigned codes).

Three principles of UDL. A second open-ended question, "What are the three principles of UDL?" was also coded into a 4 point scale (knows no principles; knows one principle; knows two principles; knows three principles). There were 9 respondents (16.1%) who answered this question and 47 (83.9%) non-responders. All of the respondents for this question rated themselves as "agree" or "strongly agree" when responding to the UDL Likert Scale question, "familiarity with UDL." The percentages reported below were calculated using the total number of respondents (9) who provided an answer for this question as the denominator.

The majority of respondents (8; 88.9%) were able to list all 3 principles of UDL. The other respondent (1; 11.1%) did not know any of the 3 principles of UDL. Interrater reliability for this question was 100% with interrater agreement on 27 of 27 total coding options.

UDL professional development. A third open-ended survey question, which asked about the respondent's attendance at UDL professional development sessions, was used as the final section of the UDL familiarity score. The responses were parsed into one of the 4 pre-categorized codes (zero days, 1 - 3 days, 4 - 7 day, 8 - 10 days, and more than 10 days) regarding UDL professional development. Only 4 of the 56 respondents (7.1%) answered this question and there were 52 (92.9%) non-responders. All of the respondents for this question also rated themselves as "agree" or "strongly agree" when responding to the UDL Likert Scale question, "familiarity with UDL." The percentages reported below were calculated using the total number of respondents (4) who provided an answer for this question as the denominator.

The majority of respondents (3; 75%) attended UDL professional development sessions from *four to seven days* while the final respondent (1; 25%) attended from *one to three days* of UDL professional development. The results of this question imply that most participants of this survey have not been trained to provide instruction following the UDL framework.

MANOVAs: Familiarity of UDL and Implementation of UDL Principles and Components

Once the teacher's declared familiarity of the UDL framework was established it was used to examine research question two (What is the teacher's self-declared knowledge of the UDL principles and what is the difference, if any, between that level of self-declared knowledge and the level (considering both type and frequency) of the self-declared implementation of instructional strategies that align with UDL principles?) A MANOVA was conducted to analyze for differences between the levels of familiarity with UDL (i.e., low, medium, and high) and the implementation of the UDL principles (i.e., low and high).

To further examine the implementation of the UDL strategies MANOVAs were conducted to analyze for differences between the levels of familiarity with UDL (i.e., low, medium, and high) and the implementation of the UDL components (i.e., low and high) that aligned with each principle (e.g., UDL Principle 1 components: provide *multiple examples*, *stress/highlight critical features*, *supply multiple media and formats* and *support background knowledge*).

UDL familiarity and the implementation of UDL principles 1, 2, and 3. A

multivariate analysis of variance (MANOVA) was conducted to assess if there were differences between the three levels of familiarity with Universal Design for Learning (i.e., low, medium, and high) on a linear combination of instructional strategies that align with UDL Principle 1, UDL Principle 2, and UDL Principle 3. The assumptions of homogeneity of covariance (Box's M, p = .426) and variances (Levene' Test, [all principles] p > .05) were checked and met.

A significant difference for UDL familiarity was not found when the MANOVA was performed on the teachers' self-reported implementation of UDL principles 1, 2, and 3, Wilks' Λ = .907, *F* (50, 100) = .829, *p* = .550, multivariate η^2 = .05.

UDL familiarity and the implementation of UDL principle 1 components. A MANOVA was conducted to assess if there were differences between the three levels of familiarity with Universal Design for Learning on a linear combination of instructional strategies that align with UDL Principle 1 components (i.e., provide *multiple examples, stress/highlight critical features, supply multiple media and formats* and *support background knowledge*). The assumptions of

homogeneity of covariance (Box's M, p = .405) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for UDL familiarity was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principle 1 components, Wilks' $\Lambda = .907$, F(50,100) = .623, p = .757, multivariate $\eta^2 = .05$.

UDL familiarity and the implementation of UDL principle 2 components. A MANOVA was conducted to assess if there were differences between the three levels of familiarity with Universal Design for Learning on a linear combination of the instructional strategies that align with UDL Principle 2 components (i.e., *supply flexible models of skilled performance, provide multiple opportunities to practice with supports, provide ongoing relevant feedback*, and *offer flexible opportunities for demonstrating skills*). The assumptions of homogeneity of covariance (Box's M, p = .990) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for UDL familiarity was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principle 2 components, Wilks' $\Lambda = .875$, F(50, 100) = .86, p = .553, multivariate $\eta^2 = .06$.

UDL familiarity and the implementation of UDL principle 3 components. A MANOVA was conducted to assess if there were differences between the three levels of familiarity with Universal Design for Learning on a linear combination of instructional strategies that align with UDL Principle 3 components (i.e., offer *choice of content and tools, provide adjustable levels of challenge*, and *provide choice of rewards*). The component *offer choices of learning context* did not have a high enough internal consistency (alpha .44) when examined with the other UDL Principle components and therefore could not be used in the analysis. The assumptions of

homogeneity of covariance (Box's M, p = .860) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for the MANOVA was found, Wilks' $\Lambda = .757$, *F* (50,100) = 2.49, *p* = .028, multivariate $\eta^2 = .13$. Examination of the coefficients for the linear combinations distinguishing levels of familiarity with UDL indicated that the instructional strategies that align with the component *provide adjustable levels of challenge* contributed most to distinguishing the groups. In particular, *provide adjustable levels of challenge* ($\beta = -.378$, *p* .023, multivariate $\eta^2 = .1$) contributed significantly toward discriminating group 1 (low UDL familiarity) from the other two groups. *Offer choice of content and tools* and *provide choice of rewards* did not contribute significantly to distinguishing any of the groups.

Follow-up univariate ANOVAs indicated that the component *provide adjustable levels of challenge*, when examined alone, were significantly different for teachers with different levels of familiarity of UDL. The findings for *provide adjustable levels of challenge* were F(2, 52) = 6.16, p = .004.

A Tukey HSD post hoc analysis was conducted finding a significance difference in the implementation of the component *provide adjustable levels of challenge* between teachers with low and medium UDL familiarity, p = .003. Tukey's HSD revealed that instructional strategies that align with the component *provide adjustable levels of challenge* were implemented more often for teachers with medium familiarity with UDL (M = 1.73, SD .46) than they were implemented by teachers with low familiarity with UDL (M = 1.22, SD = .43). A near significant difference (p = .059) was found for this component between teachers with low and high UDL familiarity (M = 1.60, SD = .5).

MANOVAs: Years Teaching and the Implementation of the UDL Principles and Components

In order to determine if other factors contributed to the implementation of the instructional strategies that align with the UDL principles and the UDL principle components, MANOVAs were conducted to analyze for differences between the levels of years teaching (i.e., 0- 9 years, 10 - 19 years, and 20 - 33 years) and the implementation of the instructional strategies that align with UDL principles (i.e., low and high).

To further examine the implementation of the UDL instructional strategies, MANOVAs were conducted to analyze for differences between the levels of years teaching (i.e., 0- 9 years, 10 - 19 years, and 20 – 33 years) and the implementation of the instructional strategies that align with each of the UDL components (i.e., low and high) that correspond to each UDL principle (e.g., UDL Principle 1 components: provide *multiple examples, stress/highlight critical features, supply multiple media and formats* and *support background knowledge*).

Years teaching and the implementation of UDL principles 1, 2, and 3. A multivariate analysis of variance (MANOVA) was conducted to assess if there were differences between the three levels of years teaching (i.e., 0 - 9, 10 - 19, and 20 - 33) on a linear combination of the instructional strategies that align with UDL Principle 1, UDL Principle 2, and UDL Principle 3. The assumptions of homogeneity of covariance (Box's M, p = .970) and variances (Levene' Test, [all principles] p > .05) were checked and met.

A significant difference for years of teaching was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principles 1, 2, and 3, Wilks' $\Lambda = .929$, *F* (50, 100) = .628, *p* = .707, multivariate $\eta^2 = .04$.

Years teaching and the implementation of UDL principle 1 components. A MANOVA was conducted to assess if there were differences between the three levels of years teaching (i.e., 0-9, 10-19, and 20-33) on a linear combination of the instructional strategies that align with the UDL Principle 1 components (i.e., provide *multiple examples, stress/highlight critical features, supply multiple media and formats* and *support background knowledge*). The assumptions of homogeneity of covariance (Box's M, p = .974) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for years of teaching was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principle 1 components, Wilks' $\Lambda = .810$, F(50,100) = 1.37, p = .212, multivariate $\eta^2 = .1$.

Years teaching and the implementation of UDL principle 2 components. A MANOVA was conducted to assess if there were differences between the three levels of years teaching (i.e., 0 - 9, 10 - 19, and 20 - 33) on a linear combination of the instructional strategies that align with the UDL Principle 2 components (i.e., *supply flexible models of skilled performance, provide multiple opportunities to practice with supports, provide ongoing relevant feedback*, and *offer flexible opportunities for demonstrating skills*). The assumptions of homogeneity of covariance (Box's M, p = .943) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for years of teaching was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principle 2 components, Wilks' $\Lambda = .956$, *F* (50, 100) = .284, *p* = .970, multivariate $\eta^2 = .022$.

Years teaching and the implementation of UDL principle 3 components. A MANOVA was conducted to assess if there were differences between the three levels of years teaching (i.e.,

0-9, 10-19, and 20-33) on a linear combination of the instructional strategies that align with the UDL Principle 3 components (i.e., offer *choice of content and tools, provide adjustable levels of challenge*, and *provide choice of rewards*). *Offer choices of learning context* did not have a high enough internal consistency (alpha .44) when examined with the other UDL Principle components and therefore could not be used in the analysis. The assumptions of homogeneity of covariance (Box's M, p = .576) and variances (Levene' Test, [all components] p > .05) were checked and met.

A significant difference for years of teaching was not found when the MANOVA was performed on the teachers' self-reported implementation of the UDL principle 3 components, Wilks' $\Lambda = .786$, F(50,100) = 2.137, p = .056, multivariate $\eta^2 = .114$.

Summary of MANOVAs

UDL principles 1, 2 and 3. The MANOVA conducted using the independent variable familiarity with UDL found no significant difference between the three levels of familiarity with UDL (i.e., low, medium, high) and the implementation of the instructional strategies that align with the three principles of UDL. In addition, there were no significant differences found in the MANOVA conducted between the three levels of years of teaching experience as the independent variable and the implementation of the instructional strategies that align with the three principles of UDL as the dependent variable.

UDL principle components. There were no significant findings in the MANOVAs conducted with UDL familiarity as the independent variable and the implementation of instructional strategies that align with the UDL Principle 1 and UDL Principle 2 components.

There were significant findings for the MANOVA conducted with UDL familiarity as the independent variable and the implementation of instructional strategies that align with the UDL

principle 3 components as the dependent variables. Findings indicated that when looking at the three levels of familiarity of UDL a significant difference was found in the implementation of instructional strategies that align with the components of UDL Principle 3. In particular, as determined using a follow-up ANOVA, the implementation of instructional practices that align with the component *provide adjustable levels of challenge* contributed significantly toward discriminating group 1 (low UDL familiarity) from the other two groups.

A Tukey HSD post hoc analysis revealed that a significant difference (p = .003) existed in the implementation of instructional strategies that align with the component *provide adjustable levels of challenge* between teachers with low and medium UDL familiarity, and that teachers with medium UDL familiarity implemented this component more often than teachers with low UDL familiarity. Tukey HSD post hoc analysis also revealed that a near significant difference (p= .059) existed in the implementation of instructional strategies that align with this component between teachers with low and high UDL familiarity.

The MANOVAs conducted with the three levels of years of teaching experience as the independent variable revealed no significant difference in the teachers' implementation of instructional strategies that align with the UDL Principle 1 and Principle 2 components respectively, as the dependent variables. However, a near significant difference was found in the MANOVA conducted to compare the years of teaching experience as the independent variable based on teachers' implementation of the instructional strategies that aligned with the UDL 3 principle components as the dependent variables, Wilks' Λ neared significance with p = .056.

Crosstabulations

Crosstabulations were conducted on the categorized variables of UDL familiarity (i.e., low familiarity, medium familiarity, and high familiarity) by Total UDL (i.e., instructional

strategies that align with the UDL principles) and Technology implementation (i.e., low and high). The purpose was to examine if there was a relationship between the level of UDL familiarity and either the level of implementation of the instructional strategies that align with Total UDL or the level of implementation of technology.

Additionally, crosstabulations were conducted on the variable teaching assignment (i.e., general education or special education), by the instructional strategies that align with UDL Principle 1, 2, 3 and Total UDL. Also, crosstabulations were conducted on the variable teaching assignment (i.e., general education or special education), by Technology. Finally, crosstabulations were conducted on the variable teaching assignment (i.e., general education or special education) by the instructional strategies that align with the components of the UDL principles. In all cases, Chi Square tests were examined to determine if there was a statistically significant relationship between the categorical variables.

UDL familiarity by total UDL implementation. Crosstabulations of UDL familiarity (i.e., low, medium, and high) by the implementation of instructional strategies that align with total UDL (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 8 of the 16 respondents (50%) who were categorized as high UDL familiarity implemented the variable Total UDL at low levels. Of the 18 respondents, who were categorized as low UDL familiarity, 10 (55.6%) implemented the variable Total UDL at low levels. There were 22 respondents who were categorized as medium UDL familiarity and 12 (54.5%) of those respondents implemented the variable Total UDL at high implementation levels. This was the category with the highest level of Total UDL implementation.

However, the Pearson Chi-Square test showed that these relationships were not statistically significant, $\chi^2 = .404$, and p = .817. Cramer's V was .085 which denotes a small effect size.

UDL familiarity by technology. Crosstabulations of UDL familiarity (i.e., low, medium, and high) by the implementation of Technology (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 9 of the 16 respondents (56.3%) who were categorized as high UDL familiarity implemented the variable Technology at high levels. However, 11 of the 18 respondents (61.1%), who were categorized as low UDL familiarity also implemented the variable Technology at high levels. Of the 22 respondents who were categorized as medium UDL familiarity, 13 (59.1%) implemented the variable Technology at low implementation levels. This was the category with the lowest level of Technology implementation.

However, the Pearson Chi-Square test showed that these relationships were not statistically significant, $\chi 2 = 1.797$, and p = .407. Cramer's V was .179 which denotes a small effect size.

Teaching assignment by total UDL implementation. Crosstabulations of teaching assignment (i.e., general education, special education) by the implementation of instructional strategies that align with total UDL (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 22 of the 42 respondents (52.4%) who were categorized as general education teachers implemented the variable Total UDL at high levels while the majority of teachers categorized as special education (8 of 14; 57.1%) implemented this variable at low levels.

The results of the Pearson Chi-Square test showed that these relationships were not statistically significant, $\chi^2 = .381$, and p = .537. Phi was -.082 which denotes a small effect size.

Teaching assignment by UDL principle 1 implementation. Crosstabulations of teaching assignment (i.e., general education, special education) by implementation of the instructional strategies that align with UDL Principle 1 (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 22 of the 42 respondents (52.4%) who were categorized as general education teachers implemented the variable UDL Principle 1 at high levels while the majority of teachers categorized as special education (8 of 14; 57.1%) implemented this variable at low levels.

Pearson Chi-Square test revealed that these relationships were not statistically significant, χ^2 = .381, and *p* = .537. Phi was -.082 which denotes a small effect size. These findings mirror the results for the implementation of the variable Total UDL.

Teaching assignment by UDL principle 2 implementation. Crosstabulations of teaching assignment (i.e., general education, special education) by implementation of the instructional strategies that align with UDL Principle 2 (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 21 of the 42 respondents (50%) who were categorized as general education teachers implemented the variable UDL Principle 2 at high levels while the majority of teachers categorized as special education (8 of 14; 57.1%) implemented this variable at low levels.

The Pearson Chi-Square test showed that these relationships were not statistically significant, $\chi^2 = .215$, and p = .643. Phi was -.062 which denotes a small effect size.

Teaching assignment by UDL principle 3 implementation. Crosstabulations of teaching assignment (i.e., general education, special education) by implementation of the instructional strategies that align with UDL Principle 2 (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 22 of the 42 respondents (50%) who were categorized as general education teachers implemented the variable UDL Principle 3 at high levels while the majority of teachers categorized as special education (8 of 13; 53.8%) implemented this variable at low levels.

The Pearson Chi-Square test showed that these relationships were not statistically significant, $\chi^2 = .154$, and p = .695. Phi was -.053 which denotes a small effect size.

Teaching assignment by UDL principle 1, 2, and 3 components. Crosstabulations of teaching assignment (i.e., general education, special education) by implementation of instructional strategies that align with the UDL Principle 1, 2, and 3 components (i.e., low and high) were conducted individually to examine the relationship between the variables. Due to the number (11) of UDL principle components that were analyzed, only the analysis of the one component with statistical significance will be reported.

Teaching assignment by UDL principle 2 component: Provide multiple opportunities to practice with supports. Crosstabulations of teaching assignment (i.e., general education, special education) by implementation of the instructional strategies that align with UDL Principle 2 component *provide multiple opportunities to practice with supports* (i.e., low and high) were

conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 27 of the 42 respondents (64.3%) who were categorized as general education teachers implemented the variable *provide multiple opportunities to practice with supports* at low levels while the majority of teachers categorized as special education (12 of 14; 85.7%) implemented this variable at high levels.

Pearson Chi-Square test revealed that these relationships were statistically significance at χ^2

= 10.153, and p = .001. Phi was .433 which denotes a medium effect size.

Teaching assignment by total technology. Crosstabulations of teaching assignment (i.e., general education, special education) by the implementation of Technology (i.e., low and high) were conducted to examine the relationship between the two variables. The assumption of cell size (i.e., 0 cells had an expected count less than 5) was met.

The analysis revealed that 23 of the 42 respondents (54.8%) who were categorized as general education teachers implemented Technology at low levels while 10 of the 14 (71.4%) teachers categorized as special education implemented this variable at high levels.

The Pearson Chi-Square test revealed that these relationships were not statistically significant, $\chi^2 = 2.885$, and p = .089. Phi was .227 which denotes a small effect size.

Summary of Crosstabulations

When examining the relationship between the implementation of the variables Total UDL and Technology by UDL familiarity, no statistically significant difference was found for either crosstabulation. The only statistically significant relationship for the variable teaching assignment was with the UDL Principle 2 component, *provide multiple opportunities to practice with supports*. This variable was implement at a low level by 64.3% (27/42) of the general education teachers and at a high level by 85.5% (12/14) of the special education teachers who responded to this survey. Pearson Chi-Square test was $\chi^2 = 10.153$, and p = .001. Phi was .433 which denotes a medium effect size.

Qualitative Analysis of Interview

Interviews were conducted to try and garner more information about participant's familiarity with UDL and their instructional practices as they pertain to the implementation of both instructional strategies that align with UDL Principle 1, 2, and 3 and Technology. The responses to the interview questions were entered into Excel documents and categorized according to UDL familiarity or the implementation of instructional strategies that align with UDL Principle 1, UDL Principle 1, UDL Principle 2, or UDL Principle 3. As stated earlier three of the survey respondents agreed to participate in a phone interview and a summarization of the interview follows. (See Appendix B for the interview questions.)

Interviewees Familiarity with UDL. The same questions were use to determine UDL familiarity for both the interviewees and the survey respondents. Interviewees were asked to rate their familiarity with UDL using a Likert scale rating of 1 to 5 (1 strongly disagree to 5 strongly agree) regarding whether they were familiar with the term. They were also asked three open ended questions: 1) Explain UDL to a peer (i.e., equivalent of survey question, What do you think UDL mean?).; 2) What are the 3 principles of UDL?; and 3) How much UDL professional development have you attended? The responses were then coded using the same criteria that were used for the Likert scale and open-ended survey questions (refer to table 7).

After coding the questions the researcher found that the interviewees were spread across the three levels of UDL familiarity. One interviewee had low UDL familiarity, one had medium UDL familiarity, and one had high UDL familiarity. The interviewee with the highest level of UDL familiarity attended 6 days of UDL professional development and rated him/herself as a 4.5 for familiarity with UDL. The other two interviewees had not attended any professional development and rated themselves as 1 (strongly disagree) and 2 (disagree), respectively, for the Likert scale question regarding their familiarity with UDL.

The interviewee who rated him/herself as a one regarding his/her familiarity with UDL was not asked any further questions regarding his/her knowledge of UDL. Neither of the other two interviewees could state the 3 Principles of UDL although both interviewees were able to partially explain UDL to a peer. The first interviewee was able to state that UDL includes "varied options to allow for success for all types of learners" and the second said he/she "would describe it as designing lessons to meet all the kids needs."

Interviewee implementation of UDL Principle 1. Interviewees were asked to respond to the question "When you present your lessons to your class what are some of the strategies you use to address the diversity of the students you teach?" This question pertained to UDL Principle 1 Multiple Means of Representation. The use of *manipulatives* for math was one of the strategies that 2 of the interviewees noted they used to support their students during math instruction. One went on to state that he/she stresses moving from concrete to abstract during math instruction. Another strategy that was employed was *video*. Two of the interviewees mentioned that they used video and in later statements each specifically mentioned using video to support student development of background knowledge.

Interviewee implementation of UDL Principle 2. Interviewees were asked to respond to the question "What strategies do you use to support the diverse learning needs of the students in your classroom?" This question pertained to UDL Principle 2 Multiple Means of Action and Expression. The use of *reduction in the amount of* writing was one strategy that 2 of the

interviewees noted. Both stated that not all students are expected to write the same amount. Specifically one said, that he/she allows students who struggle with writing to "do lists, outline, or use graphic organizers" rather than requiring them to write an entire essay. The other stated that he/she had "some students write 3 sentences while others write a paragraph." Both of these interviewees also went on to stress that they use *projects* in their classrooms to support the learning needs of their students. Both stated that they allowed students to use *presentations* to demonstrate their learning. *Drawing* was also mention by one of the respondents and another mentioned letting students use *Flip cameras* (i.e., create video) to demonstrate learning.

Interviewee implementation of UDL Principle 3. Interviewees were asked to respond to the question "What strategies do you use to support student engagement in your classroom?" This question pertained to UDL Principle 3 Multiple Means of Engagement. Two of the three interviewees stressed how they manage the environment to support learners in their classrooms. Both mentioned the use of alternate seating (e.g., sensory or yoga balls) and allowing students to move around the room as necessary to learn (e.g., movement to learn, stretch thera bands while learning).

One of the respondents did mention that he/she tried to relate learning to a students interest and another noted that he/she does offer choice of content, specifically novels for a literature circle, but only for an elective class not for core content instruction.

Interviewee implementation of technology. Interviewees were asked to respond to the question "What technology do you use in the classroom to support student learning of the content you teach?" This question pertained to the implementation of technology. All three of the interviewees mentioned technology that they used to support students in the classroom. Items such as *video streaming*, *Moodle*, and *Smart Boards* were mentioned as being used by the

teachers to support students in the classroom. Two of the three interviewees mentioned that students use text-to-speech software to help them access the curriculum. The third interviewee, when asked, did not know what text-to-speech software was. All three interviewees mentioned using software to support literacy. Two of the three noted reading software (e.g., STAR Reading, Kerzweil) and two of the three noted writing programs (e.g., Write:Outloud, Inspiration) that students use to support their learning.

CHAPTER 6

DISCUSSION

Today teachers must teach a diverse group of learners in their classrooms (D. Rose et al., 2000a; Schumm et al., 1995) and the traditional style of instruction is no longer adequate to support the diversity of today's students (Coyne et al., 2007). Teachers are currently feeling immense pressure from No Child Left Behind 2002 (NCLB) and IDEA 1997 and 2004, to ensure that all students, including students with disabilities, access the general education curriculum and become successful learners. Universal Design for Learning is a pedagogical framework that has been proposed to help teachers design curricula in a way that supports students by helping them gain access to the general education curriculum as well as becoming more successful learners.

This study sought to examine the instructional strategies that could be considered part of the UDL framework that classroom teachers were already implementing in their classrooms. Specifically, this study focused on the current implementation of instructional practices that aligned with UDL Principle 1, UDL Principle 2, and UDL Principle 3, and technology. This study also examined the teachers' implementation of those instructional practices relating to the UDL components that align with each of the UDL principles (e.g., UDL Principle 1 components: *provide multiple examples, stress/highlight critical features, supply multiple media and formats,* and *support background* knowledge). Collectively, these instructional practices were referred to as "instructional strategies." Finally, this study assessed whether teacher familiarity with UDL impacted the level at which UDL instructional strategies were implemented.

The following research questions were addressed regarding teacher implementation of the Universal Design for Learning framework:

- 1. What is the type and frequency of teacher self-declared implementation of instructional strategies that align with the UDL principles?
- 2. What is the teacher's self-declared knowledge of the UDL principles and what is the difference, if any, between that level of self-declared knowledge and the level (considering both type and frequency) of the self-declared implementation of instructional strategies that align with UDL principles?
- 3. What is the type and frequency of teacher self-declared use of technology for the implementation or completion of instructional strategies that align with the UDL principles?

For an in depth discussion of the findings, the research questions will be parsed as follows. Section one will address research question one and examine the respondents' self-declared implementation of the instructional strategies that align with either UDL Principle 1, UDL Principle 2, or UDL Principle 3. Each instructional practice also aligns with, and is assigned in the study to, one of the components of the UDL principle to which it relates and therefore will also be explored within its assigned component.

Section two will address research question two and discuss the teachers' familiarity with UDL (i.e., low, medium, high) and the difference, if any, between that level of familiarity and the level of the self-declared implementation of instructional strategies that align with the UDL principles (i.e., low, high) and the components of each UDL principle (i.e., low, high). Further section two will consider the results of the analysis of two additional independent variables, namely, years teaching (i.e., 0 - 9 years, 10 - 19 years, 20 - 33 years) and teaching assignment (i.e., general education, special education). The analysis of years teaching addressed the difference, if any, between the number of years taught and the level of the self-declared

implementation of instructional strategies that align with the UDL principles and the components of each UDL principle. The analysis of the variable teaching assignment examined the relationship, if any, between teaching assignment and the level of the self-declared implementation of instructional strategies that align with the UDL principles and the components of each UDL principle.

Section two also considers the dependent variable Total UDL. First to determine the relationship, if any, between the teachers' familiarity with UDL (i.e., low, medium, high) and the level of the self-declared implementation of instructional strategies that align with the dependent variable Total UDL. Second to determine the relationship, if any, between teaching assignment (i.e., general education, special education) and the level of self-declared implementation of instructional strategies that align with the dependent variable Total UDL.

Section three addresses research question three and will explore the teacher's self-declared use of technology for the implementation or completion of instructional strategies that align with the UDL principles, when considered in relation to the independent variables of familiarity with UDL (i.e., low, medium, high) and teaching assignment (i.e., general education, special education).

Finally, section four addresses the participants' familiarity with UDL. It focuses on their overall knowledge and awareness of UDL and posits ways to increase both knowledge and awareness of the theory.

Research Question 1 Findings

This section of the findings addresses the self-declared frequency of the implementation of instructional practices that align with the UDL Principles and their components. The results

from compiling the responses to frequency questions were corroborated by both responses to open-ended survey questions and (where applicable) interviews responses.

Instructional strategies to support representation: UDL Principle 1. This principle refers to teachers providing multiple means of representing information during instruction. The idea is that by providing instruction in multiple modalities/media one will reach the broadest range of learners in the classroom when presenting a lesson. The UDL components for UDL Principle 1 were: *provide multiple examples, stress/highlight critical features, supply multiple media and formats,* and *support background knowledge*.

Teachers who participated in this study appear to use many instructional strategies to support the implementation of UDL Principle 1, multiple means of representation, with the idea of supporting students as they learn new materials. Both survey data and interview comments related to the teachers' use of video and manipulatives to demonstrate instruction, suggesting that the teachers who participated in this study took into account the diverse learning needs of the students in their classroom and considered how these learners process information. They then strove to provide appropriately scaffolded materials to help students process the content and connect it to prior knowledge.

The interviewees related the use of video as a tool to "bridge the gap" between what was being taught and a student's background knowledge, and as a way to relate instructional information to real life. Interviewees also noted that videos help readers who are not reading at grade level access information that they would otherwise be unable to access when, for example, it is only presented in grade level text. The interviewees' comments not only corroborated the survey findings but also showed that teachers were using video in a manner that relates to the implementation of UDL components, *support background knowledge* and *supply multiple media*

and formats. Research supports the instructional strategy of incorporating video into instruction as a tool to support background knowledge and thus it can be inferred as a strategy to implement the UDL Principle 1 component *support background knowledge*. Okolo and Ferretti (1996) found in their study that text barriers can be overcome through the use of video clips. Okolo (2006) also asserts that video can be used to make knowledge more explicit and help students make connections between background knowledge and new knowledge.

Additionally, the interviewees stated that manipulatives were used as tools to help students move from the concrete to the abstract in mathematics and as a tool for modeling a concept. Thus, manipulatives were mentioned as being used in a manner that relates to the implementation of UDL components provide students with *multiple examples of a pattern or concept* and to *supply multiple media and formats* as they begin to learn new content. As Gersten and Clarke (2007) note, the opportunity to experience multiple representations of a concept, such as visual representations and manipulatives, is crucial to help students with special needs transfer their existing knowledge and develop a context for their learning. Prior research (e.g., Gersten & Clarke, 2007; Okolo, 2006) also stresses that, in order to reach diverse learners, teachers must scaffold student learning through the use of multiple media and formats to support student learning).

One final point relates to teacher use of manipulatives during instruction. As noted earlier, one interviewee shared that he/she used manipulatives as models for a concept and another one stated that he/she used manipulatives in math to support students as they move from concrete to abstract understanding of a concept. The reported use of manipulatives in these fashions relates to the UDL Principle 1 component *stress/highlight critical features*. Researchers recognize that developing an understanding of a new concept is difficult (Deshler et al., 2001)

however, by providing various examples of the concept and through its modeling, teachers can support students and scaffold them as they learn new concepts.

Instructional strategies to support action and expression: UDL Principle 2.

This principle refers to students using multiple means of action and expression to demonstrate their learning. It further addresses how students plan, execute, and self-monitor their learning. The idea is that by providing students with varying ways to express their learning teachers will be able to determine what has been learned by the broadest range of students in their classrooms. The UDL components for UDL Principle 2 focused on four practices: *supply flexible models of skilled performance, provide multiple opportunities to practice with supports, provide ongoing, relevant feedback, and offer flexible opportunities for demonstrating skills.*

Teachers who took part in this survey inidicated a high implementation of the following instructional strategies that underlie UDL Principle 2 and its components: *frequent ongoing feedback in multiple formats* and *provide process models to guide student work*. However, there was a self-reported lack of implementation of the instructional strategy related to their use of *multimedia to demonstrate knowledge*.

Both the interviewees and the open-ended survey respondents shared a number of alternative writing strategies that students were allowed to implement. This revealed that the respondents in this study valued writing as a way for students to demonstrate their learning but that they also recognized that students had different writing abilities and so they tried to offer various writing strategies to scaffold students and accommodate for their difference in abilities.

The foregoing suggests that while the teachers in this study are trying to meet student needs by offering them varying opportunities to write, they may be creating an inflexible goal because they are embedding the method to demonstrate learning (i.e., writing) in the goal of the

lesson. (If, however, the goal of the lesson is to assess the student's writing, then providing alternate ways for students to submit their written assignment would be supportive of the UDL philosophy.) Inflexible goals do not afford multiple options for student expression (Hitchcock et al., 2002) and it appears that the teachers in this study are not implementing UDL Principle 2, provide multiple means of expression, at a high level because the first step in implementing the principles of UDL is to establish clear, concise, flexible learning goals for all students (Meece, 2003; Meo, 2008). These flexible learning goals include multiple ways for students to demonstrate their learning (i.e., multiple means of expression). Again, it is important to note that teachers may not have access to materials that afford them the opportunity to provide students with diverse means of demonstrating their learning. Additionally, instructional demands, such as pacing guides, might inhibit the opportunity to allow students the time needed to complete larger projects, which allow students an alternate means to demonstrate their learning.

Instructional strategies to support engagement: UDL Principle 3. This principle refers to a teacher providing multiple means of engagement to address the diversity of the affective learning domain. The concept is that teachers provide a variety of ways to engage learners based on what attracts, motivates, or engages the learner. The UDL components used in the analysis for UDL Principle 3 were: *offer choices of content and tools, provide adjustable levels of challenge,* and *purpose choices of rewards.*

Due to the low implementation of the instructional strategies *involving student choice of tools* and *student choice of content*, the majority of survey respondents were not asked to answer the two open-ended survey questions for UDL Principle 3. Only slightly more than a quarter of the respondents were asked to complete the first open-ended question regarding UDL Principle 3, while only a third were asked to complete the second open-ended question for this principle.

The respondents who answered the first open-ended question for UDL Principle 3 ("I allow students their choice of content [e.g. book to read; report topic] for an assignment") stated that they allowed students the choice of *reading materials*, *writing topics*, and choice of *math problems* for an assignment. Respondents who completed the second open-ended question regarding UDL Principle 3, ("I allow students their choice of tools [e.g., word processor or write by hand] to complete an assignment,") stated that they allowed students the choice of *word processing, manipulatives, and graphic organizers* to complete an assignment.

Lack of implementation of these instructional strategies was further supported by the interviewee's comments. When asked about offering choice of materials or tools one interviewee stated that he/she offered choice of reading materials in his/her elective class but not in the core content classroom. The lack of choice in the core content classroom may be due to instructional demands, however that was not made clear during the interview. Another interviewee mentioned the use of word processors or traditional paper and pencil writing but it was unclear whether this was offered as a choice or whether the options were provided at different times to accommodate the diverse learning needs of the students in the classroom.

Interestingly, one of the top instructional strategies mentioned in the open-ended question regarding choice of tools was not predominantly mentioned in the answers to other related openended questions regarding either multimodal teaching strategies or student use of multimedia to demonstrate learning. The instructional strategy mentioned was the use of a graphic organizer. Seven teachers stated that students were allowed the choice to use graphic organizers as a tool. However, only one teacher mentioned a graphic organizer as a tool for student use of multimedia to demonstrate learning. This suggests that while teachers in this study allowed the use of graphic organizers as a strategy for students to organize their learning they did not necessarily

accept it as a demonstration of student knowledge. Along the same line, drawing was mentioned as being used as a multimodal teaching strategy by 12 teachers in answers to a related openended question. However, it was not mentioned at all as being an available option in response to the open-ended question relating to student choice of tools. This suggests that while the teachers in this study used drawing as an instructional strategy to support student learning, drawing was used at the teacher's discretion rather than being an available tool that a student could choose to use when the student felt its use would be beneficial.

Research Question 2 Findings

This section of the findings addresses three independent variables, namely: teacher familiarity with UDL (i.e., low, medium, high); years teaching (i.e., 0 - 9 years, 10 - 19 years, 20 - 33 years); and teaching assignment (i.e., general education, special education). The results of the various MANOVAs and crosstabulations conducted on these variables are shared below.

Teacher familiarity with UDL and the difference between levels of familiarity and the implementation of instructional strategies that align with UDL Principle 1, 2 and 3 and the components of these Principles. With respect to the independent variable teacher familiarity with UDL (i.e., low, medium and high), 4 separate MANOVAs were conducted. The purpose of each MANOVA was to determine whether there was a difference in the teacher's level of familiarity with UDL (i.e., low, medium, high) and the level of implementation (i.e., low, high) of instructional strategies that align with the UDL principles or the instructional strategies that align with the components of the UDL Principle that were the dependent variables of that MANOVA. Of the four MANOVAs conducted using UDL familiarity (i.e., low, medium, high) as the independent variable, only one found a statistical significance difference between the different familiarity levels. In that MANOVA, a statistically significant difference was found between group 1, teachers with a low level of familiarity with UDL, and their level of implementation of instructional strategies that align with components of UDL Principle 3 when compared to the other groups. Further analysis indicated that the component, *provide adjustable levels of challenge*, contributed significantly to distinguishing the difference in implementation between group 1 and the other two groups. A Tukey's HSD post hoc determined that there was a significant difference in the implementation of *provide adjustable levels of challenge* between teachers with low UDL familiarity and those with medium UDL familiarity. Respondents in this survey who had a medium level of familiarity with UDL implemented this strategy more often than those with a low level of familiarity with UDL.

The statistical analysis relating to the data from the high level of familiarity with UDL group was intriguing. On the one hand, there was no statistical difference found between the medium and high level of familiarity with UDL groups [that is, both groups statistically implement the component *provide adjustable levels of challenge* at the same level]. However, neither was any statistical difference found between the low and high level of familiarity with UDL groups [that is, both groups statistically implement the component *provide adjustable levels of challenge* at the same level]. However, neither was any statistical difference found between the low and high level of familiarity with UDL groups [that is, both groups statistically implement the component *provide adjustable levels of challenge* at the same level]. Of course, since the low and medium level of familiarity with UDL groups do not statistically implement the component *provide adjustable levels of challenge* at the same level the foregoing shows that the level at which this study's high level of familiarity with UDL group statistically implemented the component *provide adjustable levels of challenge* fell between the low and medium groups and could not be statistically distinguished from either group. However, there was a near significant difference between implementation levels for teachers with low familiarity when compared to teachers with high familiarity, while

there was very clearly no significant difference between implementation levels for teachers with medium familiarity and those with high familiarity.

In conclusion, although there is no conclusive statistical findings with respect to the high level of familiarity with UDL group, there does appear to be an impact between how often the component, *provide adjustable levels of challenge* is implemented and the level of familiarity with UDL

An underlying premise in the theory of UDL is that adjustments for learner differences are applied to all students not just those with disabilities. The significance of this finding therefore supports the concept that as teachers know more about UDL they are more likely to be aware of and focused on providing challenges tailored to each student (i.e., *providing adjustable levels of challenge*) in their instruction. Additionally, teachers who have a higher familiarity with UDL would be exposed to Vygotsky's (1978) concept of zone of proximal development (ZPD) which is incorporated into the UDL framework. The idea is that by varying the level of challenge students can work in their ZPD where learning is just beyond their current ability but not out of reach. This is the area where the best learning takes place.

Years teaching and the difference between levels of years teaching and the implementation of instructional strategies that align with UDL Principle 1, 2 and 3 and the components of these Principles. The lack of any statistically significance findings regarding the MANOVAs that examined the independent variable pertaining to years of teaching experience was an intriguing result. One might have anticipated that an increase in the number of years teaching would equate to an increase in the level of implementation of instructional strategies due to a teacher learning about more instructional strategies over time. However, regardless of teacher exposure to instructional strategies most teachers tend to continue to use the instructional
strategies that are familiar to them. This habit is one of the most pervasive barriers to change (Greenberg & Baron, 1999) as teachers tend to stay with familiar instructional strategies as the result of avoidance or fear of implementing new methods (Fullan, 2001; Greenberg & Baron, 1999). Therefore, the tendency to stay with the familiar would mean that even if the more experienced teacher knew more instructional strategies he or she would not necessarily implement them. Alternatively, it would also be reasonable to imagine that a teacher with less experience would be less wedded to a given set of instructional strategies and would be more likely to try various strategies in an effort ascertain which ones were successful. The forgoing, when considered together, might provide an explanation as to why there was not a statistically significant difference in the implementation of instructional strategies between teachers based on the number of years teaching.

Teacher familiarity with UDL and the relationship of the implementation of Total UDL. One possible explanation as to why no statistically significance difference in implementation of Total UDL was found between the groups based on familiarity with UDL is that most teachers in this study, regardless of familiarity with UDL and without regard to implementing UDL, use the instructional strategies that comprise the variable Total UDL. This fact has important significance with respect to increasing both awareness and implementation of UDL. The significance is that, as discussed previously, regardless of teacher exposure to instructional strategies most teachers tend to continue to use the instructional strategies that are familiar to them (Fullan, 2001; Greenberg & Baron, 1999). However, once teachers recognize, that regardless of their familiarity with UDL, they are already using many of the instructional strategies that underlie UDL, increasing teachers' awareness and implementation of UDL is a matter of designing the professional development and training opportunities to capitalize on their familiarity. Thus, teachers need not perceive UDL as a totally new and alien concept, but rather as an adaptation to the way they design instruction to proactively and intentionally incorporate those familiar instructional strategies into their lessons and units.

Teacher assignment and the relationship of the implementation of Total UDL, and when examined separately, the implementation of UDL principles. When examined at the broader levels there was no statistically significance between teacher assignment and the implementation of instructional practices that align with either total UDL or the individual UDL principles. This implies that whether you are a general education teacher or a special education teacher you have been exposed to a variety of instructional practices that you employ in the classroom. While general and special education teachers may learn different skills that support students in accessing instruction, overall both general and special education teachers have a strong foundation of good instructional practices.

Teacher assignment and the relationship of the implementation of components of UDL Principles 1, 2 and 3. A statistically significant difference was found between a respondent's teaching assignment (i.e., general education, special education) and their implementation of the component of UDL Principle 2 entitled *provide multiple opportunities to practice with supports*. Special education teachers implemented this component at higher levels than general education teachers.

One of the instructional strategies underlying *provide multiple opportunities to practice with supports* involves providing scaffolds for students as they attempt to master or learn (Johnston, 2008; D. H. Rose et al., 2002) a complex process (Burke et al., 1998; Larkin, 2001). This includes addressing the needs of the students at an individual level and providing differentiated opportunities for students to learn these skills. Special education teachers have an advantage in this area because their college courses address such issues. While some general education teachers may attend a college course that addresses the needs of students with disabilities historically these courses do not address instructional strategies that support students with special needs in accessing the curriculum (Kosko & Wilkins, 2009). Furthermore, higher education programs and professional development opportunities generally do not prepare general education teachers to address the diversity of students in their classrooms (Nolet & McLaughlin, 2000; Schumm, Vaughn, Gordon, & Rothlein, 1994).

Additionally, research studies have found that special education students working in general education classrooms often do not receive materials that address their individual learning differences from their general education teachers. In fact, students with special needs are often doing the same work with the same tools as their general education peers (McIntosh, Vaughn, Shay-Schumm, Haager, & Lee, 1993; van Hover & Yeager, 2003). Thus, through no fault of their own, general education teachers often have less training to address the individualized learning needs of students with disabilities and other struggling students in their general education classrooms. Therefore it stands to reason that they would implement such strategies at lower levels then their special education peers.

Research Question 3 Findings

This section of the findings addresses the self-declared frequency of the implementation of technology that supports instructional practices that aligns with UDL Principles 1, 2 and 3.

Technology to support the implementation or completion of instructional strategies that align with the UDL principles. When examining the technology that was implemented most frequently it is important to note that the technology used most, although not implemented often, supported UDL Principle 1, multiple means of representation. This aligns with other

analyses that found that instructional strategies and components of UDL Principle 1 were implemented most often. Perhaps this is because teachers are more comfortable making changes to instruction in this area. Or perhaps providing instructional strategies that address the presentation of materials to the class is not hindered as much by outside barriers such at time constraints, limited resources or instructional demands. Teachers must present materials to guide students learning so they may be able to implement these instructional strategies more easily than others, such as that of offering alternate means for demonstrating knowledge, which would require a more significant time commitment and could be impacted by pacing guides and other curricular restraints.

Teaching assignment and its relationship to the implementation of technology.

Regardless of teacher assignment there appears to be either a lack of resources, time, or knowledge about technology that would support students in accessing the curriculum. Assuming that a lack of knowledge is the prime reason for the low level of implementation would not be surprising as even special education teachers do not generally receive instruction in their college courses regarding the use of technology (or assistive technology) to support students with accessing the general education curriculum (Bausch & Hasselbring, 2004). However, it is important for teachers to become aware of and proficient in the use of technology as evidence is mounting that 21st century information and communication tools, as well as computer-assisted instructional applications, can have a positive effect on student learning processes and outcomes (Cradler, McNabb, Freeman, & Burchett, 2002).

When examining the results from the various statistical analyses done on technology, one can infer that the respondents in this study did not have a high level of implementation of technology to support instructional strategies that align with UDL Principles 1, 2 and 3.

However, the reasons for this are unknown and can only be surmised. Did teachers have access to technology? Do they have knowledge of the tools that are available to help students access the general education curriculum? Do they have time constraints or instructional demands or resource limitations that negatively impact their ability to use technology to support student learning? These are questions that cannot be answered from the data collected in this survey but are worthy of further investigation.

Summary of Familiarity with UDL

Overall, the teachers who responded to this survey had very little knowledge about Universal Design for Learning. So, one important piece to take away from this study is that although UDL has existed since 1995 (i.e., for 17 years at the time of this survey) it is not a theory that is well known to teachers; at least the teachers who took part in this study. It bears examination as to why the theory is not well known and also as to how we can increase teacher awareness of and implementation of this theory. One reason for the lack of awareness of UDL could be that it comes from the field of special education. Although UDL was developed on the premise of reducing or eliminating barriers in the curriculum for all students, the fact that it was developed in the field of special education places the theory firmly in that domain. This may also explain the participant's lack of knowledge about UDL in this study, as there were only 14 special education teachers among the 56 teachers who participated. This is not meant to imply that all special education teachers are either aware of or implement UDL as most certainly neither is the case. In fact, in this study only 4 of the 56 respondents received between 1 and 6 days of professional development in UDL and those who received training were not all special education teachers.

One idea regarding a way to increase both awareness and implementation of UDL focuses on addressing the needs of general education teachers. Since general education teachers do not often attend trainings designed to address the inclusive practices of students with special needs, it is imperative that ongoing professional development opportunities focused on those goals be provided for them (Kosko & Wilkins, 2009). Providing training opportunities on UDL would not only support general education teachers in addressing the needs of students with disabilities but would also help them support the learning needs of all students in their classroom. In addition, if trainings were created so that special education and general education teachers could collaborate and even co-plan lessons not only would the teachers benefit by sharing their expertise with one another (Dymond et al., 2006) but ultimately so would the students.

Implications

Although Universal Design for Learning is an instructional framework that is being incorporated into some Federal Policies (i.e. Higher Education Opportunities Act) and considered in others (i.e., Elementary and Secondary Education Act), it is not a framework, as evidenced by this study, that appears to be well know by teachers in the field. In this study only 4 of the 56 survey respondents noted that they had formal professional development on UDL (ranging from 1 to 6 days) and only 9 of the 56 respondents coded that they "agreed" (7) or "strongly agreed" (2) that they were familiar with the term UDL.

This, together with the statistical analyses conducted in this study demonstrate that while teachers in this study are implementing certain instructional strategies that align with and underlie the UDL framework, which is not surprising as many of the instructional strategies that align with UDL Principles are known to and used by teachers, they do not appear to be generally doing so with the intent of implementing UDL. In other words, due to the participants' general

lack of knowledge about UDL it can be assumed that the participants are not intentionally incorporating these strategies into their lessons to support the implementation of UDL. However, the findings suggest that teachers are trying to include strategies in their instruction that would support student understanding of the lesson.

This lack of knowledge about UDL indicates the need to provide ongoing professional development opportunities for teachers to learn about, practice, and reflect on the implementation of the Universal Design for Learning framework. Including general education teachers in this training would be particularly important because they are at a disadvantage in terms of receiving training that addresses supporting struggling students, including students with disabilities, in accessing the general education curriculum (Kosko & Wilkins, 2009).

Teachers who participated in this study implemented instructional strategies that align with multiple means of representation (UDL Principle 1) most often. This demonstrates that teachers are currently considering various strategies to present instruction to their students. However, when examining the types of strategies implemented most often for UDL Principle 1, it appears that teachers are helping students make connections to their learning (e.g., by providing: prompts and cues, examples of patterns, and connections between forms of information) more often than presenting materials using a variety of media (e.g., auditory or visual media). This implies that teachers in this study were focused on supporting students as they connect current learning to prior knowledge but they were less likely to do so by providing multiple means for students to access the curriculum. In some respects it appears that the participants are invested in the traditional view of teaching where teachers transmit knowledge to the students rather than as the facilitators of learning where they provide students with the tools they need to access the curriculum and co-construct what they are expected to learn. However, what is not known is whether the teachers in this study faced barriers that prevented them from altering their instruction or whether their instruction, as implemented, was in fact based on student need within the context of their lessons.

Likewise, the instructional strategies that teachers implemented to support multiple means of action and expression (UDL Principle 2) focused on supporting student understanding of the materials (e.g., provide ongoing feedback, process models to guide student's work) rather than either providing students with tools to monitor their own learning (e.g., provide guides for project completion, provide tools to evaluate work) or allowing students to express their learning in multiple ways (i.e., using multiple media/formats to demonstrate knowledge). The lack of providing tools for students to monitor their own learning suggests that teachers in this study structured student learning through feedback and by providing guidance when completing an assignment or project rather than co-constructing the learning with the students by providing tools for them to assess their learning based on teacher guidelines provided at the start of the assignment. Additionally, the lack of allowing students to demonstrate their learning in a variety of ways could demonstrate, for UDL Principle 2, that the diversity of the students' needs may not currently be addressed in the classroom. However, in the teachers' defense, educators today face extreme pressure to make sure that students do well in high stakes testing, a situation seemingly at odds with providing students opportunities to demonstrate their learning is various ways. This demonstrates only one of the instructional demands (e.g., testing pressures, curriculum demands based on school and/or district wide school improvement plans, pacing guides) that teachers face and that may inhibit their ability to afford students the opportunity to demonstrate their learning in various ways.

Teachers in this study implemented the strategies for multiple means of engagement (UDL Principle 3) by focusing on their instructional tasks (i.e., provide feedback to support student learning, provide students with opportunities to share and demonstrate learning, and provide varying level of challenge for students) rather than by providing students with options. Instructional strategies that emphasized student choice (e.g., choice of content, choice of tools) were not implemented very often. This could signify that the learning that takes place in the classroom is teacher rather than student centered. However, it is important to note that it is unknown whether the lack of choice has to do with teacher centered instruction, lack of resources, time constraints, or instructional demands.

Teachers in this study did not use technology very often. Unfortunately the level of technology to which the participants in this study had access to is unknown. However, when looking at the technology use self-reported there is a pattern of using technology to support teachers as they instruct (e.g., video to present concepts, websites to present instruction) rather than as tools for students to use to access the curriculum or demonstrate learning (e.g., text readers, speech-to-text). Thus, the nature of the use of technology to support instructional practices that align with the UDL Principles is consistent with the use of the instructional strategies themselves. The one tool that was coded as being used most often was word processing programs which can be used to develop materials for instruction as well as for allowing students to demonstrate their learning. A large percentage of respondents coded that they were unfamiliar with some of the technology referenced in the survey (e.g., reading pens, text readers, predictive writing programs) which supports the idea that students are not being offered available tools that would help them access the curriculum, in part due to the teachers' lack of familiarity with the tools. This lack of familiarity also demonstrates the need to provide teachers with the opportunity

to learn about the various technical supports available for students and to help them understand how they could incorporate those tools in their instruction to support students in accessing the general education curriculum.

Limitations

As with any research study, this study was limited by several factors. First was the small sample size. There were only 57 respondents to this survey (56 of which were analyzed), a relatively small sample size. Although there were sufficient respondents to conduct a MAVOVA, the sample size was not sufficient to allow the researcher to conduct a factor analysis. Additionally, the number of interview participants was small. While the interviewees provided insight about some of the survey responses a larger sample size may have provided additionally information or may have strengthen the responses that were provided.

The second limiting factor of this study was the survey size. The survey was extensive and was at the outer limits, in terms of both length and number of response choices, of what is recommended for survey research. Although this length and level of response choice was necessary to make sure that respondents understood the questions (i.e., question prompts were more detailed) and allowed respondents to code their answers more accurately (e.g., several lessons a day, a lesson daily) it may have inhibited the number of respondents who completed the survey. As stated earlier, while 57 respondents completed the survey, only 56 completed it sufficiently to be used for data analysis. Further, there were 29 partial surveys that were started but never completed. This indicates that the length of the survey did inhibit the response rate.

The third limiting factor of this study involved open-ended survey responses that could not be categorized into instructional strategies for data analysis. For example, 8 respondents wrote down the words "audio" or "auditory" as an instructional strategy that was implemented in

their classrooms. However, the researcher was unable to categorize these responses because the respondents could have meant either auditory media (e.g., MP3, CD) or lecture.

The final limiting factor of the study involved addressing teacher barriers to implementing instructional strategies and technology. As noted above, the size of the survey was at the outer limits in terms of length. Consequently, the researcher was unable to ask questions that addressed the availability of resources, teacher time constraints, or instructional demands that teachers face such as pacing guides. This meant that some conclusions could not be made in regard to the reason for low levels of implementation in some areas. For instance, it is unknown whether the low levels of technology implementation had to do with a lack of resources, time constraints, or instructional demands or whether the low implementation was a result of limited teacher knowledge about the technology that is available to help students access the general education curriculum.

Future Research Directions

Universal design for learning is a complex theory and is addressed in a limited number of studies. In part, this is due to the theory being left largely undefined. The rationale given for the lack of definition is that UDL needs to maintain a flexible approach so that its implementation can support the needs of the students at the classroom level. However, as with any theoretical construct, there needs to be a practical definition of UDL that can support the development of a research base. During the course of this study, Michigan's Integrated Technology Supports (MITS) in collaboration with teachers from several schools, an Intermediate School District (ISD), and the Center for Applied Special Technology (CAST), developed the UDL Critical Elements. (See Appendix C.)

The UDL Critical Elements were developed to support the implementation and research of UDL in the classroom. MITS believes that the UDL Critical Elements provide both educators and researchers with a tool to guide them as they work toward the implementation of UDL at the classroom level. While the UDL Critical Elements provide the focus to implement UDL in a recognizable manner it still allows the educator to create units and lessons with the flexibility inherent in the UDL framework. Therefore, while teachers can use the UDL Critical Elements as a guide for the implementation of UDL it will not inhibit a teacher's ability to develop flexible units and lessons based on their student learning needs. Likewise, while the researcher can use the UDL Critical Elements as a guide to determine whether the UDL framework is present, it will not constitute a mere checklist approach in defining the presence of UDL.

Given the current lack of research regarding UDL it is imperative that a focused research effort take place to determine whether the UDL framework as a whole supports student outcomes in the classroom. This can be accomplished by first conducting research to determine whether the UDL Critical Elements are the appropriate elements to distinguish whether UDL is being implemented at the classroom level. Once this question has been answered, then researchers can use the UDL Critical Elements as a guide to conduct research studies that examine the effects of the UDL framework on student outcomes.

This research study employed a survey and interview to examine whether teachers implement the instructional strategies that align with the UDL principles. It found that teachers do implement many such instructional strategies, but it appears that this implementation is unrelated to implementing UDL. In fact, with one exception, the teachers' familiarity with UDL had no effect on the level of implementation of such instructional strategies. However, the fact that teachers appear to be implementing some of the underlying UDL instructional strategies

bodes well for studying the future implementation of the UDL framework as a whole. Knowing that they are implementing some of the underlying UDL instructional strategies will increase teachers confidence and their belief that they are capable of implementing a new type of instruction (Barth, 2002; Fullan, 1993; Kosko & Wilkins, 2009) using the UDL framework. Thus allowing researchers to examine how the teachers' instructional changes affect student outcomes in the classroom.

Future studies could incorporate this survey in their research at specific locations (i.e., schools or districts) to determine the level of implementation of instructional strategies and technology that align with UDL. Once the survey is implemented, in full or in segments, the researcher could then design a UDL implementation research plan, which includes ongoing professional development, that is built on the teachers' prior knowledge and experience (McLeskey & Waldron, 2004). Additionally, the researcher could then use the UDL Critical Elements to conduct research at those locations and assess the implementation of UDL and its affect on student outcomes.

This study further demonstrated that teachers either did not have access to technology and other resources or did not have knowledge of the technology or resources that are available to help students access the general education curriculum. Creating a repository for resources within schools and across school districts could inform teachers about what is available to address the needs of struggling learners. Researchers could foster the development of repositories at the school and district level by asking teachers to share information about the materials they use to help students access the general education curriculum. The researchers could incorporate those resources into the professional development sessions that they conduct for teachers demonstrating how to overcome the barriers in the curriculum by implement these

resources to support students in their classrooms. Additionally, it would be advantageous for teachers, schools, and districts to be connected to statewide resources (e.g., grants, repositories) that support teacher's instructional efforts in the classroom. Researchers could foster this connection by incorporating information about such resources into their professional development sessions as well.

Conclusions

Teachers are expected to meet the diverse needs of the students in their classrooms. This diversity occurs in terms of varying levels of ability, differences in background knowledge, and cultural differences. All of which teachers need to understand and support. UDL is seen as a potential vehicle to help teachers address the varying needs of the students in their classrooms.

The goal of this research study was to examine whether teachers implemented the instructional strategies that support the three principles of UDL and whether that implementation was influenced by the teachers' level of UDL familiarity. It further examined the teachers' implementation of technology to support instructional strategies that align with the UDL framework. Results indicated that teachers did implement, at varying levels, the instructional strategies that underlie the UDL framework and used, at relatively low levels, technology to support those instructional strategies. However, with one exception, it found no difference between the level of implementation of such instructional strategies and a teacher's level of UDL familiarity. Nor did the study find any difference between the level of the use of technology to support such instructional strategies and a teacher's level of UDL familiarity.

The forgoing results suggest that in this study the teachers' implementation of instructional strategies that align with UDL was unrelated to the implementation of UDL. Moreover, the type of instructional strategies utilized by teachers in this study and the nature of

their use does not appear to be consistent with UDL. That is, the use of such instructional strategies appears to be consistent with the traditional view of instruction (e.g., one-size-fits-all) rather than with the creation of a flexible UDL curriculum that allows all students to both access and learn the curriculum. That being said, it is important to note that it is unknown whether teachers in this study faced additional barriers (i.e., resources, time constraints, and instructional demands) that thwarted their desire to provide a more flexible approach to instruction.

The results of this study also show that if UDL is to be used as a vehicle to address student diversity in the classroom then practicing teachers need to be offered professional development opportunities to learn about the UDL framework and how the framework can support the students in their classrooms. It is not enough for teachers to implement the instructional strategies that align with UDL. They must also have a clear and purposeful reason for taking such action and understand how such actions can lead to meeting the needs of the broadest range of learners in their classroom. The aforementioned instructional goals could be addressed by providing professional development opportunities that build upon teachers' prior knowledge and incorporate their expertise in the learning process (McLeskey & Waldron, 2004). By building upon teacher's prior knowledge and expertise they would become confident that the strategies they implement in the classroom can be provided in such a way that they increase student access to the curriculum and additionally they would understand that they are capable of implementing these strategies using the UDL framework (Barth, 2002; Kosko & Wilkins, 2009).

Additionally, the results of this study suggest that teachers need to be taught about the technology that is available and how that technology can be used to support students as they access the curriculum. For districts that lack resources or funding to purchase additional software it would be important to educate their teachers about the availability of free software programs

and resources that could support student learning. This is particularly important because the use of technology can provide students with the ability to access the curriculum independently and it can motivate them to become engaged lifelong learners.

This study started as an inquiry to examine the self-reported instructional strategies and technology that teachers implement that align with Universal Design for Learning. However, the results are broader than just examining UDL. They provide a glimpse into what teachers in today's classrooms are implementing to help students access the general education curriculum.

APPENDICES

Appendix A: Survey: Strategies that Teachers Implement to Help Students Access the

General Curriculum

Page 1

- I am currently a(n):*
- () General education teacher
- () Special education teacher
- () Itinerant/Support staff (e.g., speech and language teacher, social worker, paraprofessional)

(Exit survey if itinerant/support staff is selected.)

Thank you for offering your time to participate this survey. However, this survey is designed to

be answered by K-12 classroom teachers. I appreciate your support for this study.

Thank you,

Barb Meier

(Hidden unless you select General Education teacher.)

Do you teach any classes with a special education teacher?*

() Yes

() No

(Hidden unless you select yes to co-teaching question above.)

Answer the following questions regarding the classes you teach with a special education teacher.

Number of classes per day: _____

Subject(s):

Do you collaborate with the special education teacher to develop the lesson plan(s)?

() Yes

() No

In an average week, how many minutes do you collaborate on lesson plans?

(Hidden unless you select Special Education teacher.)

What type of special education classroom do you teach in? Check all that apply.

[] Self-contained

[] Resource room

[] Teacher consultant with direct services to students

[] Teacher consultant with no direct services to students

[] Teach with general education teacher in general education classroom

[] Other

(Hidden unless you select teach with general education teacher in the general education

classroom.)

Answer the following questions regarding the classes you teach with a general education teacher.

Number of classes per day:

Subject(s):

Do you collaborate with the general education teacher to develop the lesson plan(s)?

() Yes

() No

In an average week, how many minutes do you collaborate on lesson plans?

Page 2

Gender:

- () Male
- () Female

Is your school:

- () Urban
- () Suburban
- () Rural

Number of years teaching prior to the start of this year. (Count a semester as $\frac{1}{2}$ year and a

marking period as 1/4 year of teaching.)

	No. of Years
Years as teacher	
Years as an on-call substitute	
Years as permanent substitute (i.e., assigned to a classroom where you prepared	
the lesson plans)	

Highest degree earned:

- () Bachelors
- () Masters
- () Doctorate
- () Other (e.g., MA +30):

Areas of certification (please select all that apply):

	Certification	Endorsements
General education	[]	
Special education	[]	
Vocational education	[]	

Page 3

Grade level of current teaching assignment (please select all that apply):

[] K	[]1	[]2	[]3	[]4	[]5	[]6

[]7 []8 []9 []10 []11 []12

(Hidden unless a teacher selects multiple grade levels in the question above.)

Are you teaching in a split/combination grade level classroom?

() Yes

() No

Grade configuration of your school:

[]K-1 []K-2[]K-5

[] K-6 [] 3-5 [] 3-6

[] 5-6 [] 6-8 [] 7-8

[] 7-9 [] 8-9 [] 9-12 [] Other _____

Page 4

Subject area(s) you teach (select all that apply):

[] English/Language Arts

[] Reading

[] Mathematics

[] Science

[] History/Social Studies

[] Other

How many subject areas do you plan lessons for in a typical day? (e.g., if you teach 5 hours of the same math class, it is equal to one subject area preparation; if you teach Algebra, Geometry, and Calculus it would be considered 3 preps).

Number of subject area preps per day: _____

Are you teaching in a departmentalized setting (i.e., students receive daily instruction from

several different teachers who specialize in specific subject(s))?

() Yes

() No

As a general rule, do you collaborate to plan your lessons or do you plan your lessons independently?*

() Collaborate

() Plan independently

(Hidden unless you select Collaborate.)

With whom do you collaborate (e.g., special education teacher, general education teacher, grade

level peers)?

In an average week, how many minutes do you collaborate on lesson plans:

Page 5

Please read each item and select the frequency that best applies to that activity. If you have difficulty remembering the exact frequency then please use your best estimate when answering the question.

Please rate your frequency of the following activities. (N/A should only be used for items that are not available or not applicable given your instructional situation:

	Several lessons a day	A lesson daily	Several lessons a week	A lesson weekly	Several lessons a month	A lesson monthly	Not applicable	Don't know
I present examples to support students' development of patterns and concepts	()		()	()	()		()	()
I present nonexamples to support students' development of patterns and concepts	()		()	()	()		()	()
I help students	()	()	()	()	()	()	()	()

make								
connections								
between								
information								
provided in text								
and other forms								
of that								
information (e.g.,								
illustrations,								
charts, or								
diagrams)								
I use varied	()	()	()	()	()	()	()	()
instructional								
materials (e.g.,								
text, video,								
graphics,								
diagrams) to								
highlight or								
emphasize key								
elements/features								
of content or								
concepts								
I provide	()	()	()	()	()	()	()	()

supports (e.g.,								
outlines, graphic								
organizers,								
concept maps) to								
emphasize key								
ideas, features,								
and relationships								
among								
content/concepts								
I provide	()	()	()	()	()	()	()	()
prompts (direct								
assistance) and								
cues (indirect								
assistance) to								
help students								
recognize critical								
features of								
concepts								
I provide	()	()	()	()	()	()	()	()
auditory media								
(e.g., Digital,								
MP3, CDs of								
textbooks, books								

on tape, e-text								
read with text								
reader) to								
introduce								
concepts during								
instruction								
I provide visual	()	()	()	()	()	()	()	()
media (e.g.,								
DVD/video								
clips, You-Tube,								
animations) to								
introduce								
concepts during								
instruction								
I provide	()	()	()	()	()	()	()	()
information in								
multiple views or								
print formats								
(e.g., I change								
the size of text,								
size of images,								
contrast between								
background and								

text/image)								
I teach students	()	()	()	()	()	()	()	()
background								
information								
about a topic								
before I start a								
lesson (e.g.,								
define difficult								
vocabulary,								
explain or								
preteach difficult								
concepts,								
provide								
introductory								
materials about a								
topic)								
I help students	()	()	()	()	()	()	()	()
connect what								
they are learning								
during the lesson								
to what they								
already know								
(e.g., using								

KWL,								
anticipation								
guides,								
organizers that								
integrate new								
information and								
prior knowledge)								
I provide key	()	()	()	()	()	()	()	()
instructional								
materials in								
students' first								
language (e.g.,								
Spanish) for								
those who have								
limited-English								
proficiency								
I present material	()	()	()	()	()	()	()	()
using 2								
modalities/senses								
(e.g. visual,								
auditory, tactile,								
kinesthetic;								
activities with								
1	1					1		

written and								
verbal								
instructions)								
I present material	()	()	()	()	()	()	()	()
using 3 or more								
modalities/senses								
(e.g. visual,								
auditory, tactile,								
kinesthetic;								
activities with								
written and								
verbal								
instructions)								

If you present instruction using 3 or more multiple modalities/senses <u>at least 1 lesson or more per</u>

week, please list the top 3 multimodal teaching strategies you use (e.g. PowerPoint,

manipulatives, and lecture; activity, lecture and video clip):

	Instruction using 3 or more multiple modalities	Frequency					
		Several	А	Several	А	А	
		lessons	lesson	lessons	lesson	lesson	
		a day	daily	a week	weekly	monthly	
1.		()	()	()	()	()	

2.	 ()	()	()	()	()
3.	 ()	()	()	()	()

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Please read each item and select the frequency that best applies to that activity. If you have difficulty remembering the exact frequency then please use your best estimate when answering the question.

Please rate your frequency of the following activities. (N/A should only be used for items that are not available or not applicable given your instructional situation. Don't know should be used for the items that you do not know):

	Several lessons a day	A lesson daily	Several lessons a week	A lesson weekly	Several lessons a month	A lesson monthly	Not applicable	Don't know
I provide	()	()	()	()	()	()	()	()
examples of								
finished products								
(e.g., examples								
of completed								
projects, papers)								
to guide students'								
work								
I provide process	()	()	()	()	()	()	()	()

models to guide								
students' work								
(e.g., steps in a								
writing,								
mathematical, or								
scientific								
process, cuecards								
with strategy								
steps)								
I present students	()	()	()	()	()	()	()	()
with different								
models for								
reaching a goal								
(i.e., models that								
demonstrate the								
same outcome								
but use different								
approaches,								
strategies, skills)								
To support	()	()	()	()	()	()	()	()
students during								
the learning								
process I provide								

items such as a								
spell checker,								
calculator, atlas,								
or periodic table								
I provide	()	()	()	()	()	()	()	()
students with								
guides (e.g.,								
calendars,								
timelines) for								
breaking long-								
term projects								
into achievable								
steps								
I provide items	()	()	()	()	()	()	()	()
such as writing								
templates,								
outlining tools,								
or sentence								
starters to help								
students								
structure their								
work								

I provide	()	()	()	()	()	()	()	()
students with								
guides (e.g.,								
rubrics,								
checklists) to								
evaluate the								
quality of their								
work								
I provides	()	()	()	()	()	()	()	()
opportunities for								
students to self-								
monitor the								
completion of								
their work by								
having them use								
planners or other								
tools to track								
their assignments								
I provide	()	()	()	()	()	()	()	()
frequent ongoing								
feedback in								
multiple formats								
(e.g.,								

student/teacher								
meetings, written								
feedback, peer								
feedback)								
I share student	()	()	()	()	()	()	()	()
learning/products								
beyond the								
classroom (e.g.,								
products								
published to								
web, shared with								
other								
classrooms)								
During	()	()	()	()	()	()	()	()
instruction I								
allow students to								
use supports or								
use supports or scaffolds (e.g.,								
use supports or scaffolds (e.g., drawings,								
use supports or scaffolds (e.g., drawings, manipulatives) to								
use supports or scaffolds (e.g., drawings, manipulatives) to express/explain								
use supports or scaffolds (e.g., drawings, manipulatives) to express/explain their answers to								

I create	()	()	()	()	()	()	()	()
assignments or								
assessments that								
use multiple								
media/formats								
(e.g., text,								
speech, drawing,								
music, art) for								
students to								
demonstrate their								
knowledge								

If your students present their learning using multiple media/formats <u>at least 1 lesson or more per</u> <u>week</u>, please list the top 3 ways students use multiple media/formats (e.g. PowerPoint presentations, videos, music drawing):

	Multiple media/formats	Frequency						
		Several	A	Several	А	А		
		lessons	lesson	lessons	lesson	lesson		
		a day	daily	a week	weekly	monthly		
1.		()	()	()	()	()		
2.		()	()	()	()	()		
3.		()	()	()	()	()		

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Please read each item and select the frequency that best applies to that activity. If you have difficulty remembering the exact frequency then please use your best estimate when answering the question.

Please rate your frequency of the following activities. (N/A should only be used for items that are not available or not applicable given your instructional situation. Don't know should be used for the items that you do not know):

	Several	А	Several	А	Several	А		
	lessons	lesson	lessons	lesson	lessons	lesson	Not	Don't
	10350115	1035011	10350115	1055011	a	lesson	applicable	know
	a day	daily	a week	weekly	month	monthly		
I relate tasks to	()	()	()	()	()	()	()	()
student interest								
Within an	()	()	()	()	()	()	()	()
assignment I								
provide varying								
levels of								
challenge for								
students								
Students can	()	()	()	()	()	()	()	()
choose to use								
resources (e.g.,								
graphic								
organizers,								
-------------------	----	----	----	----	----	----	----	----
outline								
templates) in my								
classroom as								
needed to								
complete a								
lesson versus								
being assigned a								
resource that								
everyone is								
required to use								
I provide	()	()	()	()	()	()	()	()
students with								
grade guidelines								
that allow them								
to complete								
assignments at								
varying levels of								
performance/pro								
ficiency (e.g.,								
point checklist,								
scoring rubric)								
I provide	()	()	()	()	()	()	()	()

individualized								
feedback to								
support student								
learning (e.g.,								
specific written								
or oral								
comments								
regarding an								
individuals								
work)								
I provide	()	()	()	()	()	()	()	()
students with								
their choice of								
rewards or								
recognitions								
when reaching								
academic goals								
Within a lesson I	()	()	()	()	()	()	()	()
provide students								
with								
opportunities to								
share and								
demonstrate their								

learning (e.g.,								
share problem								
solving skills;								
explain their								
answers to								
others)								
I offer students	()	()	()	()	()	()	()	()
their choice of								
flexible work								
groups (e.g.								
pairs, small								
group,								
individual)								
during a lesson								
I offer students	()	()	()	()	()	()	()	()
their choice of								
activities to								
demonstrate their								
learning as								
opposed to								
offering one								
activity that all								
students must								

use to								
demonstrate their								
learning								
I offer students	()	()	()	()	()	()	()	()
their choice of								
options for								
feedback (e.g.,								
written, oral,								
peer) during								
lessons								
I allow students	()	()	()	()	()	()	()	()
their choice of								
content (e.g.								
book to read;								
report topic) for								
an assignment								
I allow students	()	()	()	()	()	()	()	()
their choice of								
tools (e.g., word								
processor or								
write by hand) to								
complete an								
assignment								

If you offer students a choice of content <u>at least 1 lesson or more per week</u>, please list the top 3 ways you allow students to choose their content (e.g. book for discussion group; topic to present report on; which mathematics problems they want to solve on a given night [Mon. even problems; Tues. odd problems]):

	Choice of content	Frequency				
		Several lessons a day	A lesson daily	Several lessons a week	A lesson weekly	A lesson monthly
1.		()	()	()	()	()
2.	·	()	()	()	()	()
3.		()	()	()	()	()

If you offer students a choice of tools <u>at least 1 lesson or more per week</u>, please list the top 3 tools you allow students to choose (e.g. word processor, spread sheet, manipulatives, calculators, writing templates, graphic organizers):

	Choice of tools	Frequency							
		Several	А	Several	А	А			
		lessons	lesson	lessons	lesson	lesson			
		a day	daily	a week	weekly	monthly			
1.		()	()	()	()	()			
2.		()	()	()	()	()			
3.		()	()	()	()	()			

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Please read each item and select the frequency that best applies to that technology. If you have difficulty remembering the exact frequency then please use your best estimate when answering the question.

Please rate your frequency of the following technologies. (N/A should only be used for items that are not available or not applicable given your instructional situation. Don't know should be used for the items that you do not know):

	Several lessons	A lesson	Several lessons	A lesson	Several lessons a	A lesson	Not applicable	Don't know
	a day	daily	a week	weekly	month	monthly		
Web activities (e.g. "Web Quest")	()	()	()	()	()	()	()	()
Predictive Writing Programs (e.g. Co- Writer, WordQ)			()		()		()	()
Word Processing	()	()	()	()	()	()	()	()

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Program								
(e.g. Word,								
Works)								
E-books	()	()	()	()	()	()	()	()
Online	()	()	()	()	()	()	()	()
textbooks								
Reading	()	()	()	()	()	()	()	()
Pens								
Organization	()	()	()	()	()	()	()	()
software								
(e.g.								
Inspiration)								
Writing	()	()	()	()	()	()	()	()
template								
software								
(e.g. Draft								
Writer)								
Specific	()	()	()	()	()	()	()	()
Websites to								
present								
instruction								
Text	()	()	()	()	()	()	()	()
Readers								

(e.g.								
Kurzweil								
Kuizwen,								
Wynn; for								
access to								
concepts)								
Video	()	()	()	()	()	()	()	()
streaming to								
present								
concepts								
Speech-to-	()	()	()	()	()	()	()	()
text software								
for writing								
(e.g. Via								
Voice;								
Dragon								
Speak)								
Computer	()	()	()	()	()	()	()	()
software								
programs								

If you use computer software programs to support student learning at least 1 lesson or more per

week, please list the top 3 programs you use:

Software	Frequency

	Several	А	Several	А	А
	lessons	lesson	lessons	lesson	lesson
	a day	daily	a week	weekly	monthly
1.	 ()	()	()	()	()
2.	 ()	()	()	()	()
3.	 ()	()	()	()	()

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Please rate your agreement level with the following statement:

When creating lesson plans I think about the learning difficulties students will face throughout the lesson and I incorporate strategies to support students prior to teaching the lesson rather than adding accommodations/modifications during instruction.

- () Strongly Agree
- () Agree
- () Undecided
- () Disagree
- () Strongly Disagree

(Hidden unless you select Strongly Agree or Agree to question above.)

What are the 3 most common steps you take to ensure student success when planning your

lessons?

- 1.:_____
- 2.:_____
- 3.:_____

Students you work with in your classroom:	No.
Total number of students in your class(es)	
Total number of students with IEPs in your class(es)	
Total number of students you consider at-risk or struggling in your	
classes (not including students with IEPs)	

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Please rate your agreement level with the following statement:

I am familiar with the term "Universal Design for Learning."

- () Strongly Agree
- () Agree
- () Undecided
- () Disagree
- () Strongly Disagree

Please state in your own words what you think Universal Design for Learning means?

Can you name the 3 principles of UDL?*

- () Yes
- () No

(Hidden unless you select yes to question above.)

List the 3 principles of UDL.

- 1.:_____
- 2.:_____

3.: _____

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Have you received any professional development in Universal Design for Learning framework?*

() Yes

() No

(Final questions hidden unless you select yes to question above.)

How much professional development have you had in Universal Design for Learning? Please list your response in days. (If the professional development did not occur in days or half day sessions

then consider 6 hours of training as one day whether it took place at the same time or not.)

Days: _____

If you have received professional development around the UDL framework, please provide three examples of how you **<u>currently</u>** incorporate it into your classroom?

- 1.:_____
- 2.: _____
- 3.:_____

If you have received professional development around the UDL framework please provide three examples of how you **plan to** incorporate Universal Design for Learning (UDL) into your classroom in the future?

1.: _____

- 2.: _____
- 3.:_____

Submission Page

Thank You!

Thank you for your participation in this survey! If you would like to be entered into a drawing

for a chance to win a \$10, \$25, or \$50 iTunes e-card or Amazon e-card, please click on the

drawing link below.

This is a separate survey and cannot be traced back to your prior responses.

ENTER DRAWING

To be entered into a drawing for the chance to win an iTunes or Amazon e-card, please provide

the following information:

Email address: _____

If selected, I would like to receive (select one):

____ A \$10 iTunes e-card

____ A \$10 Amazon e-card

Appendix B: Interview Questions

Demographic:

- 1. Are you a general education or special education teacher?
- 2. Do you teach at the elementary, middle school, or high school level?
- 3. How many years have you taught?

Lesson Planning/Accommodations and Modifications:

- When planning lessons how do you plan for the diversity of students in your classroom? (e.g., What do you think about? The range of students in your classroom; Student needs; Student strengths and weaknesses; Student engagement)
 - a. Do you use a lot of accommodations and modifications during instruction?
 - i. If so, what do you use?
 - ii. When do you implement them? (e.g., when students struggle; during reteaching)

Assessment of Familiarity of Universal Design for Learning (UDL):

- 5. On a scale of 1 to 5 rate your familiarity with Universal Design for Learning. (1 being not familiar and 5 being very familiar)
 - a. How would you explain UDL to a peer who has never heard of it? (Ask if the rating is 2 or higher.)
 - b. What are the principles of UDL? (Ask if the rating is 2 or higher.)
- 6. Have you had any training in UDL?

(If yes, continue with questions 6a – 14; if no, jump to question 15)

a. How much (6 hours equals one day of training)?

UDL Implementation:

- Have you found UDL to be helpful in your instructional practices?
 a. How so?
- 8. What are some of the benefits of implementing UDL in your classroom?
 - a. For you? (i.e., more engagement fewer discipline issues)
 - b. For your students?(i.e., students complete more assignments)
- 9. What are the most common ways that you have implemented UDL in your instruction?
- 10. How do you think UDL has changed your teaching practices?
- 11. What instructional strategies did you use prior to implementing UDL that you now realize are part of the UDL philosophy?
- 12. Which of your students do you think UDL has helped the most?
 - a. How did it help them?

- 13. Has UDL helped any other subset of students?
- 14. What differences have you noticed in the classroom that you would say are a result of implementing UDL?
 - a. Instructional?
 - b. Behavioral?

Three UDL Principles and Technology:

- 15. When you present your lessons to your class what are some of the strategies you use to address the diversity of the students you teach? (e.g., multiple modalities, software, oral text).
 - a. How do you think those strategies help your students?
 - b. Which students do you feel benefit more from using a variety of strategies?
- 16. What strategies do you use to support the diverse learning needs of the students in your classroom? (e.g., exemplars of student work; rubrics for guidelines; varied assessments to demonstrate learning)
 - a. How do you think those strategies help your students?
 - b. Which students do you feel benefit more from using a variety of strategies?
 - c. Do you offer a variety of assignments? If so what types; if not, why not?
- 17. What strategies do you use to support student engagement in your classroom? (e.g., offer students choice of materials/content/assessment; relate learning to interests)
 - a. How do you think those strategies help your students?
 - b. Which students do you feel benefit more from using a variety of strategies?
 - c. Do you offer students a choice of materials/content/assessment? If so, which do you offer most often; if not, why not?
- 18. What technology do you use in the classroom to support student learning of the content you teach? (e.g., word processing programs, text-to-speech, speech-to-text, websites)
 - a. How do you think those tools help your students?
 - b. Which students do you feel benefit more from using these tools?
 - c. If you do not use technology (or if you use little technology) what is the reason?
 - d. Are you familiar with technologies that support students who struggle when accessing the curriculum? (e.g., text-to-speech, word prediction software)

STOP HERE IF YOU HAVE ASKED THE TEACHER QUESTION NUMBER 14.

- 19. What differences have you noticed in the classroom that you would say are a result of implementing the above strategies and technology in your classroom?
 - a. Instructional?
 - b. Behavioral?

Appendix C: UDL Critical Elements



UNIVERSAL DESIGN FOR LEARNING CRITICAL ELEMENTS Developed in Collaboration with Boyne City Middle School, Charlevoix-Emmet ISD, Harbor Springs Middle School, Reese Middle School, and the Center for Applied Special Technology (CAST)

Universal Design for Learning (UDL) represents a paradigm shift in education that has the potential to improve outcomes for a broad range of students. MITS, with collaborative partners, has identified four critical elements intended to serve as a foundation for implementation and further research. Instruction aligned with the framework of UDL must minimally include **each** of the four critical elements shown below.

Clear Goals

- Goals and desired outcomes of the lesson/unit are aligned to the established content standards
- Teachers have a clear understanding of the goal(s) of the lesson and specific student outcomes
- Goals are communicated in ways that are understandable by every student in the classroom, and can be expressed by them

Inclusive, Intentional Planning

- Intentional proactive planning addressing distinct student needs
 - Addresses individual differences in background knowledge, affect, strategies, etc. (Consider what students know, strengths and weaknesses, and what engages them).
 - Recognizes that every student is unique and plans accordingly, paying attention to students in the margins (i.e., struggling and advanced) in anticipation that a broader range of students will benefit
- Addresses the instructional demands including goals, methods, materials, and assessments while considering available resources including personnel
 - Maintaining rigor of the lesson while providing necessary supports
 - Reducing the barriers in the curriculum by embedding supports during initial planning

Flexible methods and materials

- Teacher uses a variety of media and methods to present information and content
- A variety of methods are used to engage students (e.g., provide choice, address student interest) and promote their ability to monitor their own learning (e.g., goal setting, self-assessment, and reflection)
- Students use a variety of media and methods to demonstrate their knowledge

Timely progress monitoring

- Formative assessments are frequent and timely enough to plan/redirect instruction and support
- A variety of formative and summative assessments (e.g., projects, oral tests, written tests) are used to assess the learning in the classroom



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