7-23-2018

Effects of Universal Design for Learning math menus on seventh grade students

Mona L. Mauro
Rowan University, monamauro@comcast.net

EFFECTS OF UNIVERSAL DESIGN FOR LEARNING MATH MENUS ON SEVENTH GRADE STUDENTS WITH DISABILITIES

by

Mona L. Mauro

A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University
May 9, 2018

Thesis Chair: Amy Accardo, Ed.D.

Dedication

I would like to dedicate this thesis to my husband, Paul Mauro. Paul, your constant support, unconditional love, and housework take-over made it possible for this study to be completed. Your faithful prayers, along with God's unfailing grace, strengthened and encouraged me along the way. Thank you, Babe.

Acknowledgement

I would like to express my sincerest appreciation to my professor, Dr. Amy Accardo. Dr. Accardo, thank you for not only being professional, patient, and supportive, every step of the way, but for overflowing with compassion, understanding, and kindness when life took several unexpected turns. Without your guidance and humanity, this study would not have been possible.

Abstract

Mona L. Mauro
EFFECTS OF UNIVERSAL DESIGN FOR LEARNING MATH MENUS ON SEVENTH GRADE STUDENTS WITH DISABILITIES
2017-2018
Amy Accardo, Ed.D.
Master of Arts in Special Education

The purpose of this study was to: (a) examine the effectiveness of UDL math menus in increasing the academic engagement of seventh grade students with disabilities, (b) examine the effectiveness of UDL math menus in increasing the academic achievement of seventh grade students with disabilities, and (c) determine if seventh grade students with disabilities are satisfied with the use of UDL math menus. The research was conducted using single-subject design methodology. The study followed an ABAB alternating baseline pattern. Student academic achievement was evaluated through daily assessments, while student engagement was evaluated five times per class, approximately every fifteen minutes daily. The results of this study suggest that the use of UDL math menus may help to increase the academic engagement and academic achievement of seventh grade students with disabilities. UDL math menus were found to increase the weekly mean engagement score for students, and the weekly mean academic achievement score for all students in the first intervention phase. Results also show that all students were satisfied with the use of UDL math menus. Implications for educating students with disabilities in a resource room setting include the recommendation to utilize additional education technologies such as UDL math menus in the classroom.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

List of Figures

Figure Page

List of Tables

Chapter 1

Introduction

Mathematics is embedded into our everyday lives in many ways and is very evident in our technology-rich society (Little, 2009). More than any other subject, the teaching of mathematics lends itself to the memorization of facts, procedures and algorithms. Traditional teaching practices that flow from this philosophy are demonstration, repetition and individual practice (Friesen, 2008). Yet, according to the National Center for Education Statistics, only 27% of eighth grade students are proficient in math, and students with specific learning disabilities (SLD) perform even worse (Cuenca-Carlino, Freeman-Green, Stephenson, & Hauth, 2015).

One-way educators prepare lessons that meet the needs of students with learning disabilities is through the use of Universal Design for Learning (Vitelli, 2015). Universal Design for Learning (UDL) is a research-based model for curricular design that ensures participation for all students (Zascavage, 2009). It is based on the understanding that learning environments should include instruction, curriculum, and instructional materials that are accessible to all students, regardless of learning ability (Basham, Israel, Graden, Poth, & Winston, 2010). The UDL framework is developed around providing multiple means of engagement, action and expression (Cook, Rao, & Collins, 2017). UDL offers educational choices for the student's demonstration of knowledge and diversity in how the students are engaged. UDL reduces barriers in instruction by providing appropriate accommodations, supports, and challenges, while maintaining high achievement expectations for all students, including students with disabilities (Basham, Israel, Graden, Poth, & Winston, 2010).

The principles of UDL allow all students access to the methods, materials, and technology that can maximize their learning in the classroom (Zascavage & Winerman, 2009). A UDL menu provides a variety of instructional options targeted toward important learning goals. Students select the choices which most appeal to them. The teacher directs the menu process, but the student is given control over his/her choice of options, order of completion, etc. (Burns, 2016). The menus contain levels, or choices, of accessibility, which are accomplished through the use of UDL practices of proactive instructional design, and instructional strategies to support multiple means of knowledge, representation, engagement, and expression of understanding (Basham, Israel, Graden, Poth, & Winston, 2010).

A UDL math menu can offer a variety of experiences at a range of levels of difficulty to meet different students' needs, further allowing for differentiation (Burns, 2016). Differentiating instruction offers different paths to understanding content and process, considering what are the appropriate strengths, interests, and preferences of each child (Dixon, Yessel, McConnell, & Harden, 2014). To provide a way to assess progress, some sections of a menu are completed individually. To further the understanding of specific concepts or explore something new, other sections can be completed in pairs (Burns, 2016). The incorporation of technology has been one-way, UDL has enhanced individualized assessment and instruction (Zascavage & Winterman, 2009). One website used for menus is IXL Math (https://IXL.com/). IXL Math supports learners in making connections to past problems and topics (Botzakis, 2017). Another is Quizlet (https://quizlet.com/), a computer-based word-matching program, with word games that can

supplement teacher instruction and enhance vocabulary development for students with LD (Miller, 2016).

Statement of Problem

Mathematics is challenging but extremely important for all students to learn. The teaching of mathematics lends itself to procedures where students memorize steps, often by rote (Friesen, 2008). Making connections between what is currently taught and previously learned is vital; yet the inability to make these mathematical connections is a common characteristic of students with learning disabilities possibly due to long-term memory deficits, e.g., the inability to easily store and retrieve information, such as number facts or the steps of algorithms (Cuenca-Carlino et al., 2015). An individual with a learning disability, also possesses a higher risk of co-occurring conditions such as attention-deficit/hyperactivity disorder, reading disabilities, mathematics learning disabilities, and communication impairment which may affect learning in mathematics (Koepke & Miller, 2013). Students with LD have difficulty remembering all the steps in complex problems, recalling the orders of operation, organizing information, selecting appropriate strategies, calculating with integers, monitoring problem-solving techniques and solving quadratic equations (Cuenca-Carlino et al., 2015).

As a child reaches adolescence it is expected they stride toward independence in their thinking, working and decision-making. A major developmental achievement is for a teenager to function on a given task without the constant supervision of an adult (Hume, Boyd, Hamm, & Kucharczyk, 2014). Yet, many students with disabilities expend limited independent effort on a task, despite having the necessary knowledge to be successful (Kurz, Talapatra, & Roach, 2012). They often develop a *learned helplessness* and

display it in the classroom by their unwillingness to engage in a task because failure is predetermined (Kurz et al., 2012). Students with learning disabilities show limited independence at a task due to an overreliance on prompts, feedback and insecurities (Hume et al., 2014).

Significance of Study

While research exists on UDL, differentiated instruction, independence and mathematics instruction, there is a scarcity of available research specifically investigating the use of UDL math menus in the general, and/or special education classroom. There is a plethora of materials available for creating, managing and implementing UDL math menus, but the results of using UDL menus with learning disabled students, have not been empirically studied. The present study is significant in that it appears to be the first study to investigate the effectiveness of UDL math menus on students with disabilities. UDL math menus may be especially helpful to special education teachers. UDL math menus are flexible because they can be implemented in conjunction with the Common Core Standards and curriculum that districts are mandated to teach.

Purpose of Study

This study will evaluate the effectiveness of UDL math menus on seventh grade students with learning disabilities in a Resource Room math class. Specifically, it will investigate the effect of UDL math menus on their academic scores and ability to work independently.

Research Questions

1) Will the use of UDL math menus increase the academic scores of students with learning disabilities in mathematics?

2) Will the use of UDL math menus increase the academic engagement and focus of students with learning disabilities in mathematics?

3) Will students with learning disabilities be satisfied with the use of UDL math menus?

Key Words

For purposes of this study, *Universal Design for Learning* is defined as a research-based model for curricular design that ensures participation for all students (Zascavage, 2009) through instruction, curriculum, and instructional materials that are accessible to all students, regardless of learning ability (Basham et al., 2010).

For purpose of this study, *Differentiating Instruction* is offering different paths to understanding content and process, considering the appropriate strengths, interests, and styles of each child (Dixon et al., 2014).

For purpose of this study, a *UDL Math Menu* is defined as a list of math options including problems, investigations, games, technology and other activities that promote student's understanding (Burns, 2016).

For purpose of this study, *engagement and focus* is defined as a student being on task during an activity with the absent of adult prompting (Hume et al., 2014).

Chapter 2

Literature Review

Universal Design for Learning

Universal Design for Learning, (UDL), is an instructional approach that addresses learner differences by removing obstacles in the curriculum (Lowery, Hollingshead, Howery, & Bishop, 2017). Through intentional planning, educators design materials, interactive activities, and detailed instruction with the flexibility to match individual learners' strengths and needs, so all students can have access to the objective (Canter, King, Williams, Metcalf, & Potts, 2017). In UDL there is often an array of options that provide each student a range of learning opportunities, including technology (Canter et al., 2017). In a UDL curriculum the objective provides an appropriate challenge for all learners, materials provide multiple depictions of content, and methods are diversely flexible (Hitchcock, Meyer, Rose, & Jackson, 2002).

The Center for Applied Special Technology (CAST), a nonprofit research organization dedicated to the UDL approach, defines it as "*a set of principles for curriculum development that give all individuals equal opportunities to learn. UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone – not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs"* (CAST, what is UDL section, 2012, para.1).

Architect and founder of The Center for Universal Design, Ron Mace, formulated the Universal Design (UD) as a method for designing environments that are manageable for everyone (Canter et al., 2017). Designing buildings with the needs of diverse users in mind, instead of adding ramps and automatic doors later, is more streamlined and works better for

all (Hitchcock et al., 2002). The Center for UD at NC State University and CAST adapted the UD principles for educational purposes (Courey, Tappe, Siker, & LePage, 2013). UD created a way to help everyone navigate the physical world, just as UDL creates a way to help students navigate learning (Canter et al., 2017). The UDL instructional framework primarily includes three principles: engagement - the "why" of learning, representation - the "what" of learning, and action and expression - the "how" of learning (Lowery et al., 2017).

A review of the literature reveals that the innovative practices of UDL hold potential for students with learning disabilities (Canter et al., 2017). Studies have shown that students with diverse learning needs are not "the problem," but rather the obstacles lie within the curriculum (Hitchcock et al., 2002). Implementation of UDL guidelines in the classroom have resulted in reports of effectiveness in teaching, increased engagement and the ability to reach diverse learners (Lowery et al., 2017). A UDL framework in the classroom creates an environment where students with learning disabilities may succeed, despite the barriers within the curriculum (Hitchcock et al., 2002). Research indicates that UDL-based teaching delivers learning outcomes for students with or without disabilities (Vitelli, 2015).

General Curriculum and Standards

There has been a shift in education from a general curriculum of textbooks, teacher guides, workbooks, and assessments to a curriculum driven by external national and statewide standards (Hitchcock et al., 2002). These standards aim to clearly express the knowledge, skills and expectations that schools value, and teachers teach and assess (Hitchcock et al., 2002). There is an increased pressure in meeting the benchmark proficiency standards, high stakes testing, and student performance expectations (Anderson, 2007). The changes in society and technological advances have forced change in United

States' public schools. The increase in diversity, push for inclusion, use of technology, and standard-based curriculum are pressing challenges (Canter et al., 2017). Often this general yet difficult, curriculum does not consider the diverse needs of students with learning disabilities (Hitchcock et al., 2002).

Students with Learning Disabilities

Because of the provision of least restricted environment in 2011, 61% of students with learning disabilities found themselves in general education classrooms, an increase from 32% in 1989 (Vitelli, 2015). Students with disabilities often face an unusable curriculum filled with barriers, because the printed textbook remains at the center of the curriculum (Hitchcock et al., 2002). Students with learning disabilities face a complex variety of struggles in this challenging curriculum where varying instructional delivery is limited. These students may develop negative attitudes with curricula that limit their ability to comprehend information (Marino, Gotch, Israel, Vasquez, Basham, & Becht, 2013). Often general education teachers set low expectations of students with learning disabilities and those same students fail to engage because of complex vocabulary (Marino et al., 2013). The UDL guidelines address the characteristics of many students with disabilities: lack of engagement, overt behavior, off-task behavior or/and poor academic outcomes (Cook, Rao, & Collins, 2017). All educators should possess the skills to meet the needs of students with disabilities (Vitelli, 2015).

Students with Disabilities in the Middle School Math Classroom

The Common Core State Standards (CCSS) and standards of the National Council of Teachers in Mathematics (NCTM, 2000) call for a rigorous mathematics curriculum, more creative teaching approaches and a greater access to higher-level mathematics for all students (Cuenca-Carlino, Freeman-Green, Stephenson, & Hauth, 2016). In the United States 7% of all children are diagnosed with a math disability. Moreover, 17% -65% have a reading disability which effects mathematics understanding (Koepke & Miller, 2013). Students in the United States are not performing as well in mathematics as other developed countries (USDOE, 2000). Only 2% of students in the United States achieved advanced levels of mathematics by grade 12 (Little, 2009). According to National Assessment of Educational Progress (NAEP) data, only 27% of all eighth-grade students are proficient in mathematics (Cuenca-Carlino et al., 2016). Understandably, students with learning disabilities perform even worse (Cuenca-Carlino et al., 2016). Researchers agree that we need new approaches to help students learn mathematics (Friesen, 2008).

The transition from elementary school to middle school is challenging, especially for students with learning disabilities. The complexity of their distinct learning needs magnifies the transition (Zascavage, & Winterman, 2009). Middle school student with learning disabilities often struggle with solving math word problems, due to the inability to read and understand various scenarios (Shin, & Bryant, 2017). More than half of students with learning disabilities have some difficulty with the language of mathematics (Thomas, Van Garderen, Scheuermann, & Lee, 2015). They typically perform two grade levels behind their peers without disabilities, failing to understand core concepts of algorithms and operations (Little, 2009). Only 5% of students with learning disabilities enter the math field

workforce, even though they have the ability (Marino et al., 2013).

Coinciding with a specific learning disability (SLD), many students possess additional conditions such as attention-deficit/hyperactivity disorder (ADHD), and memory issues. The more complex the disability, the more particular challenges the learner possesses. (Koepke, & Miller, 2013). According to Steele and Steele (2003), students with memory insufficiencies have difficulty recalling the steps in math problems, remembering order of operations, and calculating with integers. Memory is important in making connections in mathematics from what is taught to what was learned (Cuenca-Carlino et al., 2016). Students use their working memory to store and use many pieces of information for a short time. Those with learning disabilities have long-term memory deficits and the inability to store and retrieve needed information (Cuenca-Carlino et al., 2016).

To effectively engage in learning mathematics students must have the knowledge and proper usage of key terminology. Mathematics vocabulary is complex and differs from everyday treatment of certain terms (Thomas et al., 2015). It involves communication, shared vocabulary and interpretation of symbols. A strong vocabulary awareness seems foundational to knowledge in mathematics (Thomas et al., 2015). Word problems and the language of mathematics can be challenging for students with learning disabilities as they need to solve accurately and interpret precisely (Shin, & Bryant, 2017).

Mathematics lends itself to procedural steps where students memorize and complete actions that are usually taught by demonstration, repetition and individual practice (Friesen, 2008). A teacher must take the time to develop background knowledge, explain strategy, model the concept and have student practice with support (Cuenca-Carlino et al., 2016). For the student with learning disabilities the mathematics concept should be broken down into

manageable chunks and repetitive practice should be offered (Friesen, 2008).

UDL Planning

Teachers should refer to UDL guidelines and check points in designing instructional goals, assessments, methods, and materials (Cook et al., 2017). In traditional lesson planning all students complete the same type and amount of practice (Anderson, 2007). Through intentional planning with UDL guidelines educators can remove barriers in the curriculum, address student access to understanding information, and create lessons where students engage with content and express what they know (Lowery et al., 2017). UDL provides teachers guidance for addressing engagement, increasing relevance, fostering collaboration and facilitating personal coping skills (Cook et al., 2017). Careful planning and implementing of UDL guidelines may reduce challenging behaviors if student learning needs are met. Needs of students with IEPs can be addressed through UDL planning (Courey et al., 2013). Today's teachers must instill critical thinking skills into students, so they know the why and how of learning rather than just the what (Canter et al., 2017). When teachers maximize the strengths of students, independent learners evolve (Lowery et al., 2017).

UDL Goals

In a UDL curriculum, the goal or standard, provides an appropriate challenge for all students, even those with disabilities (Hitchcock et al., 2002). The goal reflects a skill all students can strive for because the teacher provides multiple measures to achieve it. UDL increases access for all learners by eliminating the barriers found in the general curriculum (Hitchcock et al., 2002). Once the goal is determined, various means and media supports are implemented with flexibility to help students learn (Hitchcock, Meyer et al., 2002).

Many studies have been conducted on the implementation of UDL in the mathematics classroom, yet very few explicitly include learners with learning disabilities (Lowery et al., 2017).

UDL Assessment

A UDL assessment requires a clear understanding of the learning goal (Hitchcock et al., 2002). Educators must build assessment into the learning by having an ongoing dialogue with the student of daily constructive feedback, both written and oral (Friesen, 2008). In a study conducted by Friesen (2008) she identified building assessment into teaching as beneficial. By designing a rubric that the students could constantly use throughout their lessons, students were able to find proof of learning and set personal goals for the following day.

UDL Methods and Materials – Differentiated Instruction

UDL guidelines focus on increasing access to the curriculum and instruction by providing diversity in methods and materials through multiple means of representation, expression and engagement. With instruction and Interventions individualized for general education and special education, differentiation is achieved (Cook et al., 2017). This approach provides flexibility to meet each individual learners' strengths and needs – so all students have access to learning (Canter et al., 2017). No single method can reach all learners. In a UDL classroom students are able to use multiple means of expressing their knowledge and select from a variety of options (Hitchcock et al., 2002). Instruction is personalized to meet the learning needs of students as math concepts are represented in a variety of ways until student grasps ideas (Friesen, 2008).

In a study conducted by Scigliano and Hipsky (2010) a UDL framework was

implemented to instill differentiation into a classroom using the following three guidelines. First, students were instructed to complete a learning profile. This profile was used to determine each student's individual strengths, preferences, and learning styles. Through observation and student interview, a learning contract was written with activities that were geared to each student's strengths and to give each student opportunities to engage in learning outside their preferences. The contract spelled out any needed accommodations and was signed by teacher and student. Students then were given a pretest (formal or informal) to determine student ability. This pretest determined tiers for support and incorporated leveled groups. Finally, Scigliano and Hipsky gave a menu of choice to determine student interests. The students decided what motivated them to learn. A menu or Tic Tac Toe choice board was offered. This differentiation offered choice to all learners – gifted, general or exceptional. (Scigliano et al., 2010)

UDL Math Menu

A UDL math menu is a choice board with teacher-predetermined options challenging students at all levels. Each student selects which activities to complete, is responsible for their own learning and demonstrates what they know by representing their own understanding with preferences, interests and strengths (Anderson, 2007). Students complete a designated number of selections in the order they choose. Menu options should be familiar enough to students that they can work independently, as the independent work is used for assessing student's understanding (Burns, 2016). A UDL math menu should include tiers of independent work activities, learning centers and individualized homework enrichment projects (Anderson, 2007). Students not only achieve the content benchmark, but are exploring, creating, making decisions, and playing an important role in their own

learning process (Anderson, 2007).

Differentiated instruction is applied by giving students choice in the UDL math menu. Learners may choose their method of exploration by working independently, with a partner, or as a team (Anderson, 2007). There should be math games for partner work to practice skills, apply reasoning and use strategic thinking (Burns, 2016). Rather than competition there is cooperative learning with motivational and emotional involvement (Hitchcock et al., 2002). Students may pick to work at a table, a desk or a carpet square (Anderson, 2007), and should feel empowered and in control of their learning (Burns, 2016).

Logan (2009) investigated the use of differentiated instruction, specifically the impact of providing students with choice, flexibility, on-going assessment and creativity through choice boards in the classroom. When using choice boards students evidenced positive levels of engagement, motivation and excitement. Logan (2009) used varying ways to modify content- learning contracts, leveled small groups, and variety of reading/skill levels. She discovered that the average student completing math homework had a higher achievement score than students who did not.

Use of Technology

In the elementary years students with learning disabilities may not have needed technology for additional support. With the increased academic demands of middle school technology is necessary for word prediction, spell check, research, presentations and projects. Incorporating technology into the classroom varies methods and options for students (Zascavage & Winterman, 2009). According to CAST (2007), UDL uses technology to supplement content, and to enhance assessment and instruction. Technology

supports multiple means and is fundamental to implementing a UDL instructional design (Basham, Israel, Graden, Poth, & Winston, 2010).

UDL technology provides multiple representations through digital media, displayed on various electronic devices, making it possible to offer a varied curriculum (Hitchcock et al., 2002). Educational video games provide teachers with multiple measures and repeated practice (Marino et al., 2013). As long as the learning goal is steadfast, there are many benefits to the flexibility of technology. Students may choose medium or media most effective for their needs (Hitchcock et al., 2002). Botzakis supports IXL.com as a supportive technology that can be used to give users the ability to review past mathematics learning and get hints about the task at hand. (The IXL.com scoring system on IXL.com, however, could be discouraging to those that struggle with mathematics (Botzakis, 2017).

Engagement / On-Task Learning

The general standard-based curriculum may be viewed as boring, irrelevant or unfair. Students may choose to expend little effort even though they have skills to be successful (Kurz, Talapatra, & Roach, 2012). When students lack motivation their level of achievement is low. Students with learning disabilities are not motivated to be engaged by high-stakes testing (Kurz, Talapatra et al., 2012). According to Harlem and Crick, to have these students engaged they need a supportive staff and focused on-task specific learning goals.

Adolescence is typically a time of increasing independence and behavior responsibility (Hume, Boyd, Hamm, & Kucharczyk, 2014). The multi-period, multi-teacher structure demands additional need for independence from students with learning disabilities (Hume, et al., 2014). Independence is defined as on-task engagement in an activity in the

absence of adult prompting (Hume & Odom, 2007). Active engagement and participation follow when the curriculum challenges and allows students to experience success. When student goals are connected to classroom content, meaning is developed, and the result will be engagement (Kurz et al., 2012).

There are varied methods for evaluating student engagement or on-task behavior (Kurz et al., 2012). The Behavioral Observation System in Schools (BOSS; Shapiro, 1996) represents a formal approach of recording student engagement using time samplings (Kurz et al., 2012). Self-monitoring engagement for attention or academic performance is ideal (Cook et al., 2017). When a student self-monitors for attention, his or her behavior and academics generally improve. Self- monitoring for academic performance leads to accuracy of work, independence, and decreases off-task behavior (Cook et al., 2017). Self-monitoring their own behavior places the onus on the student (Hume et al., 2014).

Summary

Anne Meyer and David Rose first laid out the principles of UDL in the 1990s. This review of the literature reveals that UDL can be an effective instructional framework to improve classroom instruction and student engagement (Canter et al., 2017). In the UDL framework the learner is at the center of the teaching and learning process, not the curriculum (McTighe, & Brown, 2005).

The framework of UDL as a math strategy is well supported with general education students (Cuenca-Carlino et al., 2016). Several studies have reported the effectiveness of UDL in teacher effectiveness and reaching diverse learners. There is great promise of UDL for these students, but more information is needed to investigate the impact of UDL on student outcomes (Lowery et al., 2017).

The literature suggests that UDL math menus support differentiated instruction, offer student choice and student engagement (Anderson, 2007). The checkpoints included in the UDL framework and math menus, have been supported with research, but empirical findings supporting improved student outcomes are scarce (Rao, Ok, & Bryant, 2014). The current study seeks to extend the findings of Meyer and Rose and to consider the effect of UDL math menus on the academic achievement and academic engagement of students with learning disabilities.

Chapter 3

Methodology

Setting

School. This study was conducted in a middle school in suburban New Jersey. The district has seventeen schools, including three middle schools. This middle school includes students in sixth through eighth grade. During the 2017-2018 school year, there were 608 students enrolled in the school with 148 of them having special needs. During the 2016-2017 school year there were 567 students enrolled with 133 having special needs. According to the NJ School Performance Report for 2016-2017, 46.2% of the students in the school were Hispanic, 34.7% were White, 15.7% were Black, 2.5% were Asian and 0.4% were American Indian (New Jersey Department of Education, 2016). During the 2015-2016 school year, 23% of the students were identified as having disabilities, 47% were considered economically disadvantaged, and 2% were identified as English Language Learners. During 2016-2017, the Partnership for Assessment of Readiness for College and Careers (PARCC) assessment was administered, and 35.7% of students met or exceeded expectations on the English Language Arts/Literacy portion, and 64.3% did not meet the target. On the math portion of the assessment, 71.6% met or exceeded expectations, and 29.4% of students did not meet the target.

Classroom. This study was conducted in a classroom designed for smaller groups. There was a cart with chrome books, an apple TV, two teacher desks, twelve student desks and twenty student lockers. The study took place in the students' math class during 8th and 9th periods, from 1:34-2:55 daily. All students in the study were classified as having a disability. All students were in seventh grade at the time of the study.

Participants

Table 1 presents the basic information of the participants.

Table 1

Participant Information

Student	Age	Grade	Classification
A	13	7	CI
B	13	7	SLD
C	13	7	SLD
D	13	7	SLD
E	13	7	SLD
F	13	7	SLD
G	13	7	CI

Student A. Student A is a thirteen-year-old seventh grade Asian male who is classified as communication impaired (CI). In 2015 he was given the KTEA and was determined to be below average to low in all academic composite areas. All achievement abilities were in the "low" range. He did not meet expectations on the mathematics portions of the PARCC. In spring 2016 he scored a 698, and in spring 2017 he scored a 685. Student B is consistent with homework completion, yet easily distracted during class. In mathematics, he earned a B and C during the first two marking periods of the school year.

Student B. Student B is a thirteen-year-old seventh grade Hispanic male who is classified with specific learning disability (SLD). He is soft-spoken, limits his verbal

output, and is very well-liked by his classmates. Spanish is the main language spoken at home. In 2017 he was given the KTEA and in math computations received a 108-standard score, which equates to a 6.10 grade level. He partially met expectations on the mathematics portions of the PARCC tests in spring 2016 with a 722 and did not meet expectations with a 669 in spring 2017. Student B is inconsistent with homework completion, and easily distracted during class. In mathematics, he earned a B and C during the first two marking periods.

Student C. Student C is a thirteen-year-old seventh grade White male who is classified with a SLD. He has a WISC IV full scale IQ of 81 and is considered in the low average range of intellectual ability. On the 2017 KTEA, he scored a 77-standard score on math computations, representing a 3.8 grade equivalency. Student C is consistent with homework, yet easily distracted during class. In mathematics, he earned an A during the first two marking periods. He partially met expectations in math on PARCC tests in spring 2016 with a 709, and in spring 2017 with a 698.

Student D. Student D is a thirteen-year-old seventh grade Black male who is classified with SLD. He is a very respectful student, consistent with homework completion and exhibits a desire to succeed. According to the WISC IV, his full-scale IQ of 87 falls in the low average of intellectual ability. He did not meet expectations in math on PARCC tests in spring 2016 or spring 2017, receiving a 698 each year. In mathematics he earned a C and A during the first two marking periods.

Student E. Student E is a thirteen-year-old Black female who is classified with a SLD. She is a very respectful student, consistently completes her homework, and cares about her school work. According to the WISC IV, her full-scale IQ of 89 falls in the low

average range of intellectual ability. KTEA results in math applications report an 88 as a standard score, with a 4.3 grade equivalency. Her 2017 math PARCC score of 685 did not meet expectations. In mathematics she earned an A for the first and second marking periods.

Student F. Student F is a thirteen-year-old Hispanic female who is classified with a SLD. She is soft-spoken, limits her verbal output, and is very well-liked by her classmates. Student F has a math reasoning disability, but she works diligently to succeed in the classroom. Student F earned a 2017 KTEA math application standard score of 64, with a 1.1 grade equivalency. Her 2017 math PARCC score of 677 did not meet expectations. I n mathematics she earned a C for both the first and second marking periods.

Student G. Student G is a fourteen-year-old Hispanic male who is classified as CI. According to 2017 KTEA results, his math application standard score was 88, with a 4.8 grade equivalency and math computation standard scores of 8.6, with a 5.2 grade equivalency. He has communication delays, is inconsistent with homework, does not desire to share, and is inconsistent with this effort of kindness toward classmates. He did not meet expectations in math on PARCC tests in spring 2016, scoring a 685, or in spring 2017, scoring a 698. In mathematics he earned a B and C during the first two marking periods.

Materials

UDL math menu. The UDL math menu students followed throughout each phase was created with a variety of leveled math concepts. Students were given a UDL Math Menu, with accompanying rubric and with leveled activities to glue in their math notebook. These menus were also posted on the board and available in google classroom. Each nine menu options were explained to all students.

Lesson materials. The following nine activities were a part of the UDL Math Menu: (1) IXL Math Lesson from IXL.com

(2) Quizlet vocabulary words to enter and review using *quizlet.com*

(3) Versatiles – a tile game to create patterns for self-checking

(4) Small group lesson

(5) Small group review

(6) Partner games for review

(7) Maze puzzle review work

(8) Face-ing Math Puzzle

(9) Coloring sheet for review

A daily exit ticket was provided based on lessons from the menu. For an example UDL menu see Figure 1.

Name: _____ Date: _____ Period: _____

Ratios & Proportions Menu

Date Due: February 21st

IXL **Solve Proportions: Word Problems** (min 85%) 5 Points _____	**Game** **Partner Ratio and Proportion** **"Ratio Runway" Game** Show all work. 5 Points _____	**Versatiles:** **Rate Yourself! & Coming to Terms** Show all work. 5 Points_____
Unit Rate Maze . Show all work 5 Points _____	**Quizlet** Create Flashcards for the list of required words. Each flash card must contain a complete definition and picture. 5 Points _____	**Ratios and Proportions Color by Number** Show all work. 5 Points _____
{MANDATORY} **Small group** **How can proportional relationships be graphed?** **>Homework 4<** Show all work. 5 Points _____	**{MANDATORY}** **Small group** **How are proportional relationships represented?** **>Homework 5<** Show all work. 5 Points _____	**FACE-ing Math** **Ratios & Unit Rate** Show all work. 5 Points _____

You will complete the above MENU as part of your weekly class assignments. The total points you have completed by the due date will be graded as a quiz grade. You must work diligently in order for the menu points to be accomplished. You may earn up to 5 points for extra credit for completing the entire menu.

TOTAL POINTS NEEDED: 35

TOTAL POINTS EARNED: _____

Figure 1. Example UDL menu

Survey

At the end of the study, students completed a survey to assess the social validity of using UDL math menus using a Likert scale of 1 (strongly disagree) to 5 (strongly agree). Students placed an X in the column for the number that best represented their feelings. Students rated statements regarding the usefulness, ease, and enjoyment of the UDL math menu strategy. Figure 2 shows the survey that students completed.

Directions: Read each sentence below and place an X in the column you feel most accurately indicates your feelings.

Statements	Strongly Agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly Disagree (1)
I found the UDL Math Menu easy to use.					
The UDL Math Menu kept me on task.					
I would rather use technology to stay on task.					
The UDL Math Menu was a distraction.					
I would use the Quizlet Application in other classes or settings to help me study.					
I enjoyed using the UDL Math Menu in class.					
I am prepared for math tests and quizzes after using the UDL Math Menu.					
I would like to share the Quizlet technologies with friends and other students.					
I would like to complete UDL Math Menus again.					
Working with partners was my favorite part of using UDL Math Menus					

Figure 2. Social validity survey

Research Design

Data was gathered for phase A, Baseline, using direct instruction with group and independent practice for five days. An exit ticket containing five questions related to the lesson was given at the end of each day. The exit ticket was scored with a total score of ten points each day.

During phase B students participated in UDL math menu activities with student choice for five days. On day one instruction was given on each menu option, how to pace completion in agenda, and rubric explanation for assessment. During the remainder of the four days students were expected to independently work through the menu options. During phase A, the third week, students participated in four to five days of direct instruction, group practice and independent practice. Each day, during phase A and B, an exit ticket was given to assess mastery. For the second phase A, using direct instruction, independent and group work, new concepts would be introduced. The final week, phase B, a new UDL math menu was introduced. The dependent variables included student achievement and student engagement.

Procedures

Phase A: baseline, direct instruction. The study was conducted for four weeks. A new unit on ratios and proportions began during the first week. Direct Instruction was used to introduce ratios and proportion for five days.

Phase B: UDL math menu on ratios and proportions. The UDL math menu #1-Ratios and Proportions, phase B, was introduced. Students were given the UDL math menu on a typed sheet of paper with nine math activities. The menu was also displayed in the classroom and placed on the class' google classroom. A total of seven of the nine options

needed to be completed for full credit. Of the seven, two were mandatory. Eight lessons, with directions, were individually printed on paper and placed on a table in the classroom. One IXL lesson was to be completed on the computer, as well as a quizlet.com activity. Each paper option stated to "Show all work." Following a ten minute daily "do now" and ten-minute mini lesson, students were given 35 minutes daily to work on their menu. Each student was given a folder to organize their work. It was optional for them to keep with their work or have teacher keep in the classroom. Individual assistance and help was provided as needed. Daily students were encouraged to pace themselves on how to complete all seven lessons within the five days. As students completed each option, teacher or para-professional would check for mastery, initial and date the menu. Work was collected. An exit ticket was given daily to assess mastery. Students could earn up to ten points for each daily exit ticket.

Five times throughout the 80-minute class, approximately every 15 minutes, students were assessed for engagement and attentiveness. If they were on task, students were given a "Y", representing "yes, attentive and engaged" in learning. When observed, if students were distracted or not participating in lesson an "N", representing "not attentive and engaged" was recorded. Students were then given two points for each observed "yes, engaged" or a zero for each "not engaged".

Phase A: Direct instruction and individual practice. During the third week class began with a fifteen minute do now activity (with small groups), a thirty-minute lesson with direct instruction and teacher modelling lesson, student practice and an exit ticket. During the student practice there were opportunities of partner sharing and review. Teacher and para-professional walked the room starring correct answers and redirecting with

encouragement. Homework was recorded in agendas and exit ticket was given. Assessment for engagement and attentiveness was completed in the same manner as for each phase.

Phase B: UDL math menu #2 on ratios and proportions. A new UDL math menu #2- Linear equations and Graphing, was introduced for second phase B. Students were given the UDL math menu on a typed sheet of paper with nine math activities. It was also placed in classroom and on class' Google Classroom. Seven of the options needed to be completed for full credit and of them, two options were mandatory. Seven lessons, with directions, were individually printed on paper and placed on a table in the classroom. Two were IXL lessons to be completed on the computer, and one quizlet.com activity. Each paper option stated to "Show all work." Following a ten minute daily "do now" and ten-minute mini lesson, students were given 35 minutes daily to work on their menu. Each student was given a folder to organize their work. Individual assistance and help was provided as needed. Daily, students were encouraged to pace themselves on how to complete all seven lessons within the week. As students completed each option, teacher or para-professional would check for mastery, initial and date the menu. Work was collected. An exit ticket was given daily to assess mastery. Students could earn up to ten points for each daily exit ticket.

Measurement Procedures

All student UDL Math Menus were scored out of 35 points, with each option worth a minimum of zero and maximum of five points. If an option was completed incorrectly, demonstrating misunderstanding, the student was given clarification and a chance to correct their work for more credit. If students completed more than the seven required options, up to five additional points would be accrued. The daily exit tickets were scored on a scale of

one to ten.

Data Analysis

Daily exit ticket scores for all four weeks were recorded on a spreadsheet. Each student's mean and standard deviation were calculated for the dependent variables of achievement and engagement during each phase. The means were compared across all phases. Graphs were created to visually analyze the data.

Chapter 4

Results

Academic Achievement

Research question one asked, will the use of UDL math menus increase the academic achievement of students in a seventh-grade resource room mathematics classroom? Student academic achievement was evaluated daily using a five-question assessment, worth a total of ten points, administered at the end of each class period. The assessment questions served as a direct review of the content taught in that day's lesson. Means and SD of each student's academic achievement were calculated and are presented in Table 2.

Table 2

Mean and SD of Academic Achievement Scores

	Baseline 1		Intervention 1		Baseline 2		Intervention 2	
Student	Mean	SD	Mean	SD	Mean	SD	Mean	SD
A	5.80	1.79	7.00	1.4 0	6.33	2.07	6.75	2.06
B	3.80	2.05	4.40	1.52	4.33	1.37	5.00	0.82
C	7.00	2.00	9.60	0.55	9.80	0.45	8.75	1.50
D	7.00	2.80	7.75	1.26	8.17	1.47	6.75	1.89
E	7.60	2.19	9.40	0.89	9.50	0.84	9.33	1.15
F	6.40	1.67	9.33	1.15	9.00	1.22	8.00	2.83
G	3.75	1.26	5.50	3.11	6.00	4.32	7.00	2.45

In the area of student academic achievement, the group mean for Baseline 1 was 5.85, and the group mean at Intervention 1 was 7.55. The group mean for Baseline 2 was 7.59, and the group mean at Intervention 2 was 7.29. The first Intervention phase showed a higher group mean than the first Baseline phase. All students had individual Intervention 1 means higher than their Baseline 1 means. However, only Student A, B and G had Intervention 2 means higher than the group Baseline 2 mean.

Individual Results – Academic Achievement

Student A is a thirteen-year old seventh grade Asian male who is classified as Communication Impaired. He was found by the district to qualify for resource room services for math. Figure 2 illustrates the academic achievement scores in points for Student A. During the Baseline 1 and Intervention 1, Student A's mean academic achievement score rose from 5.80 to 7.00. During Baseline 2 and Intervention 2, student A's mean academic achievement score rose from 6.33 to 6.75. Student A's mean score consistently rose with both Interventions.

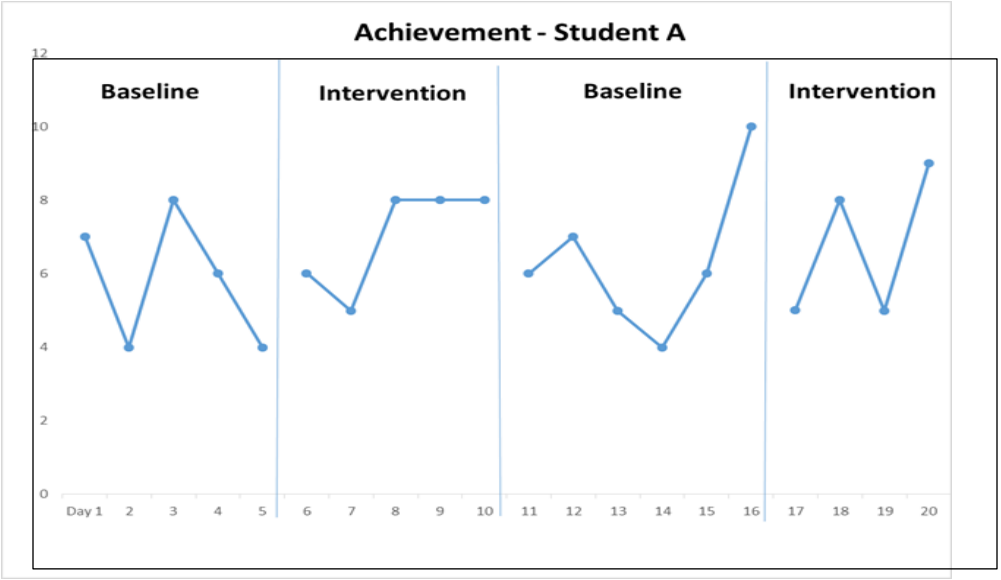

Figure 3. Achievement – Student A

Student B is a thirteen-year-old seventh grade Hispanic male who is classified with Specific Learning Disability. He was found by the district to qualify for resource room services. Figure 3 illustrates the academic achievement scores in points for Student B. During the Baseline 1 and Intervention 1, Student B's mean academic achievement score rose from 3.80 to 4.40. During Baseline 2 and Intervention 2, student B's mean academic achievement score rose from 4.33 to 5.00. Student B's mean score consistently rose with both Interventions.

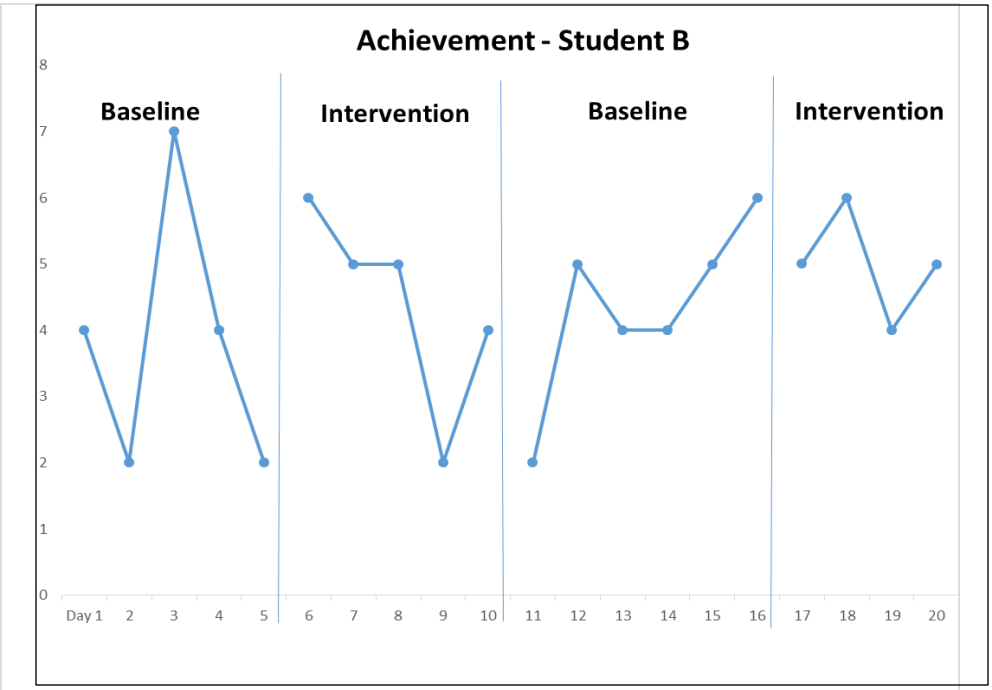

Figure 4. Achievement - Student B

Student C is a thirteen - year old seventh grade White male who is classified with Specific Learning Disability. He was found by the district to qualify for resource room services. Figure 4 illustrates the academic achievement scores in points for Student C. During the Baseline 1 and Intervention 1, Student C's mean academic achievement score rose from 7.00 to 9.60. During Baseline 2 and Intervention 2, student C's mean academic achievement score fell from 9.80 to 8.75. Student C's mean score rose with the first Intervention and fell with the second.

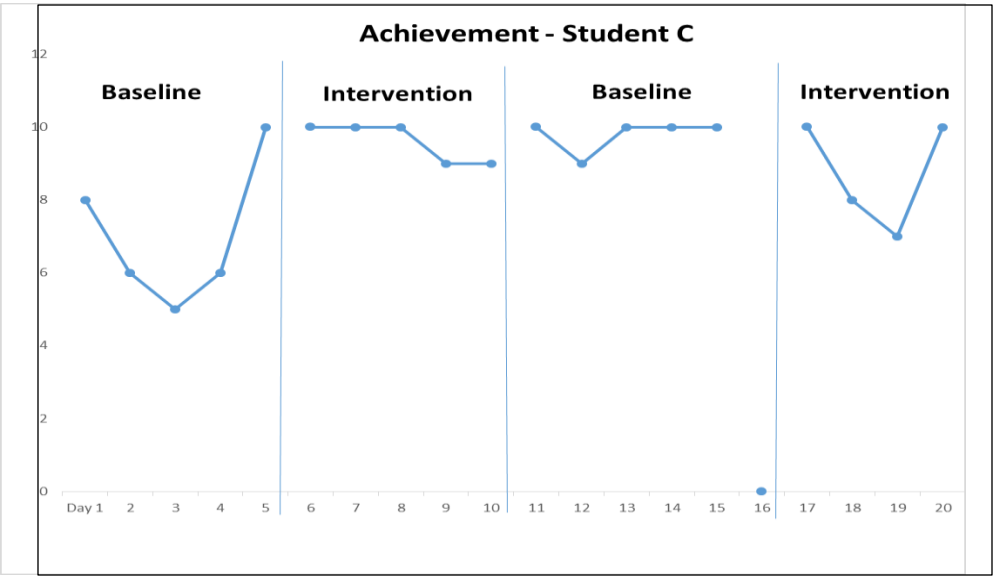

Figure 5. Achievement - Student C

Student D is a thirteen-year-old seventh grade Black male who is classified with Specific Learning Disability. He was found by the district to qualify for resource room services. Figure 5 illustrates the academic achievement scores in points for Student D. During the Baseline 1 and Intervention 1, Student D's mean academic achievement score rose from 7.00 to 7.75. During Baseline 2 and Intervention 2, student D's mean academic achievement score fell from 8.17 to 6.75. Student D's mean score rose with the first Intervention and fell with the second.

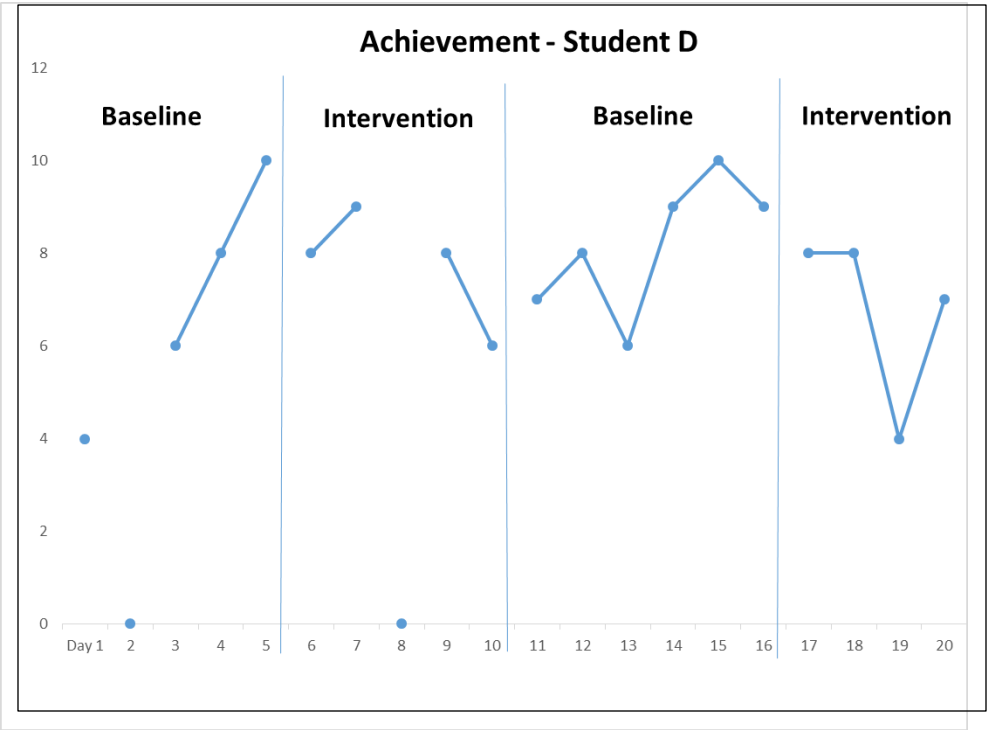

Figure 6. Achievement – Student D

Student E is a thirteen-year-old seventh grade Black female who is classified with Specific Learning Disability. She was found by the district to qualify for resource room services. Figure 6 illustrates the academic achievement scores in points for Student E. During the Baseline 1 and Intervention 1, Student E's mean academic achievement score rose from 7.60 to 9.40. During Baseline 2 and Intervention 2, student E's mean academic achievement score fell from 9.50 to 8.00. Student E's mean score rose with the first Intervention and fell with the second.

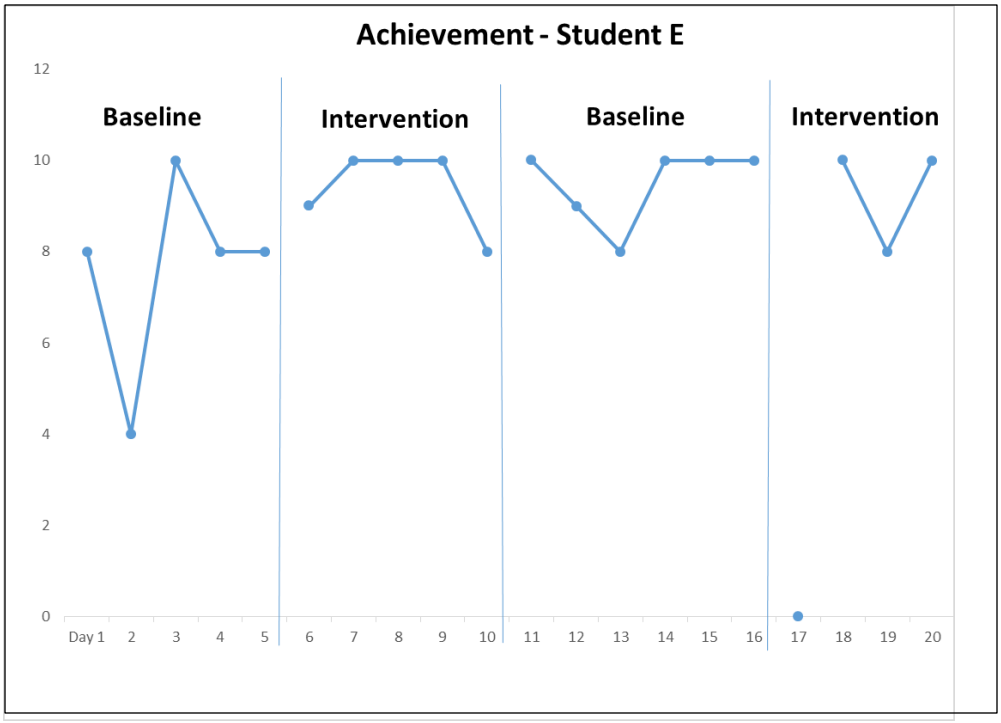

Figure 7. Achievement – Student E

Student F is a thirteen-year-old seventh grade Hispanic female who is classified with Specific Learning Disability. She was found by the district to qualify for resource room services. Figure 7 illustrates the academic achievement scores in points for Student F. During the Baseline 1 and Intervention 1, Student F's mean academic achievement score rose from 6.40 to 9.33. During Baseline 2 and Intervention 2, student E's mean academic achievement score fell from 9.00 to 8.00. Student F's mean score rose with the first Intervention and fell with the second.

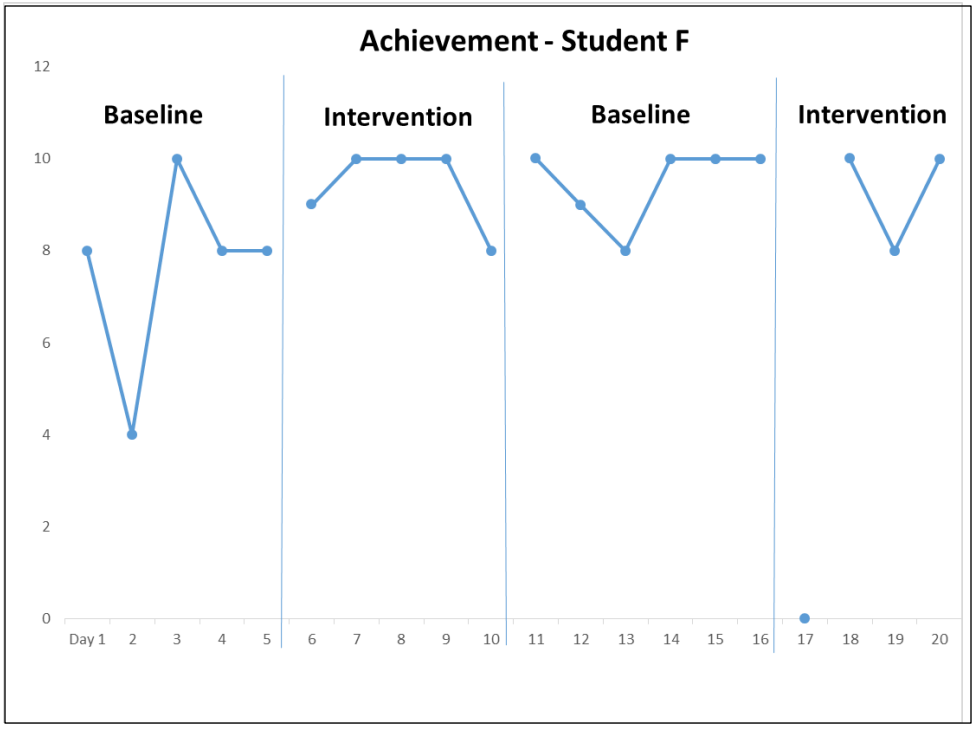

Figure 8. Achievement – Student F

Student G is a fourteen-year-old Hispanic male who is classified with a Communication Impaired Disability. He was found by the district to qualify for resource room services. Figure 8 illustrates the academic achievement scores in points for Student G. During the Baseline 1 and Intervention 1, Student G's mean academic achievement score rose from 3.75 to 5.50. During Baseline 2 and Intervention 2, student B's mean academic achievement score rose from 6.00 to 7.00. Student G's mean score consistently rose with both Interventions.

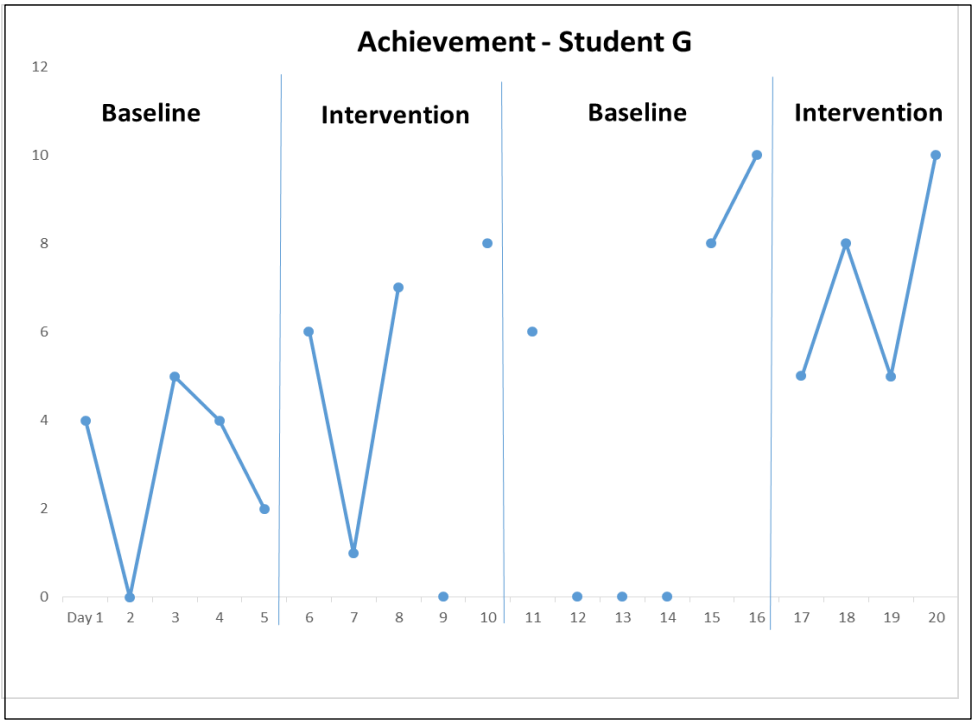

Figure 9. Achievement – Student G

Academic Engagement

Research question two asked, will the UDL math menu increase the academic engagement of students in a seventh-grade resource room mathematics classroom? Student academic engagement was evaluated five times during class. An engagement checklist was utilized to record student engagement five times during each double period, which was every fifteen minutes. A *Y*, for *Yes, on task*, was used to indicate that the student was displaying on-task behavior at the time. An *N*, for *Not on task*, was used to indicate that the student was displaying off-task behavior at the time. The maximum points a student could earn was 10 points. Means and Standard Deviations (SD) of each student's academic engagement were calculated and are presented in Table 3.

Table 3

Mean and SD of Academic Engagement Scores

	Baseline 1		Intervention 1		Baseline 2		Intervention 2	
Student	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
A	8.00	2.00	7.20	1.79	6.50	1.76	7.50	1.00
B	5.20	1.79	6.40	2.19	4.33	2.94	7.25	0.96
C	4.80	2.39	7.20	3.35	8.80	1.10	9.00	1.15
D	9.50	1.00	9.00	1.15	8.17	2.23	10.00	0.00
E	8.80	1.10	9.20	1.10	9.17	0.98	8.66	1.15
F	8.80	1.10	10.00	0.00	9.40	1.34	9.50	1.00
G	8.50	1.91	7.00	3.40	6.50	3.42	7.00	3.46

In the area of student academic engagement, the group mean for Baseline 1 was 7.52, and the group mean at Intervention 1 was 7.89. The group mean for Baseline 2 was 7.50, and the group mean at Intervention 2 was 8.40. The first Intervention phase showed a slightly higher group mean than the first Baseline phase. The second Intervention phase showed a higher group mean than the second Baseline. Students B and C had higher academic engagement means on both Interventions than Baseline means.

Individual Results – Academic Engagement

Student A is a thirteen-year-old seventh grade Asian male with IEP modifications including: frequently check for understanding, modify pace of instruction to allow additional processing time and additional time to complete classroom quiz/test. Figure 9 illustrates the academic engagement scores in points for Student A. During the Baseline 1

and Intervention 1, Student A's mean academic engagement score fell from 8.00 to 7.20. During Baseline 2 and Intervention 2, student A's mean academic engagement score rose from 4.33 to 7.25. Student A's mean score dropped during first Intervention and rose with second Intervention.

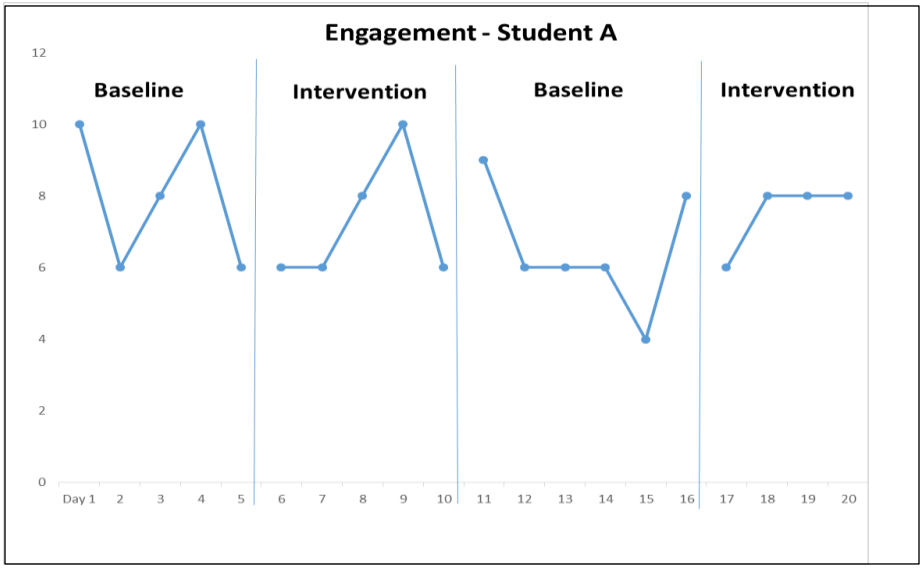

Figure 10. Engagement – Student A

Student B is a thirteen-year-old seventh grade Hispanic male with an IEP modification including: frequently check for understanding. Figure 10 illustrates the academic engagement scores in points for Student B. During the Baseline 1 and Intervention 1, Student B's mean academic engagement score rose from 5.20 to 6.40. During Baseline 2 and Intervention 2, student B's mean academic engagement score rose from 4.33 to 7.25. Student B's mean score improved consistently during Intervention 1.

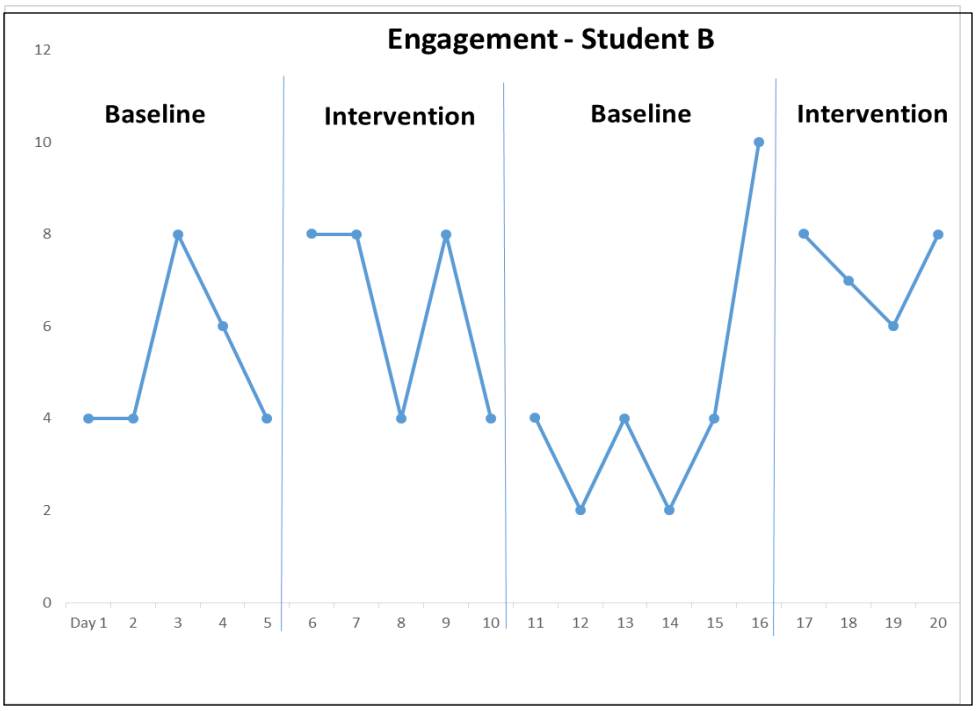

Figure 11. Engagement – Student B

Student C is a thirteen-year-old seventh grade White male with IEP modifications including: frequently check for understanding and break down multi-step tasks into smaller key components. Figure 11 illustrates the academic engagement scores in points for Student C. During the Baseline 1 and Intervention 1, Student C's mean academic engagement score rose from 4.80 to 7.20. During Baseline 2 and Intervention 2, student C's mean academic engagement score rose from 8.80 to 9.00. Student C's mean scores consistently rose during both Interventions.

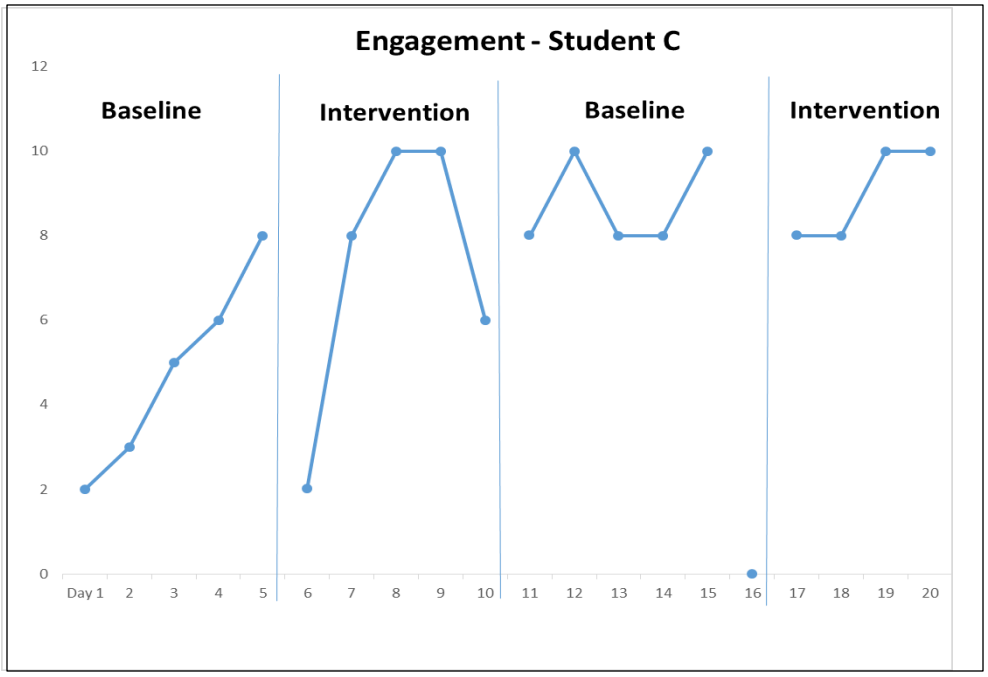

Figure 12. Engagement – Student C

Student D is a thirteen-year-old seventh grade White male with IEP modifications including: additional time to complete tests/quizzes and break down multi-step tasks into smaller key components. Figure 12 illustrates the academic engagement scores in points for Student D. During the Baseline 1 and Intervention 1, Student D's mean academic engagement score fell slightly from 9.50 to 9.00. During Baseline 2 and Intervention 2, student D's mean academic engagement score rose from 8.17 to 10.00. Student D's mean score fell during the first Intervention and rose during the second.

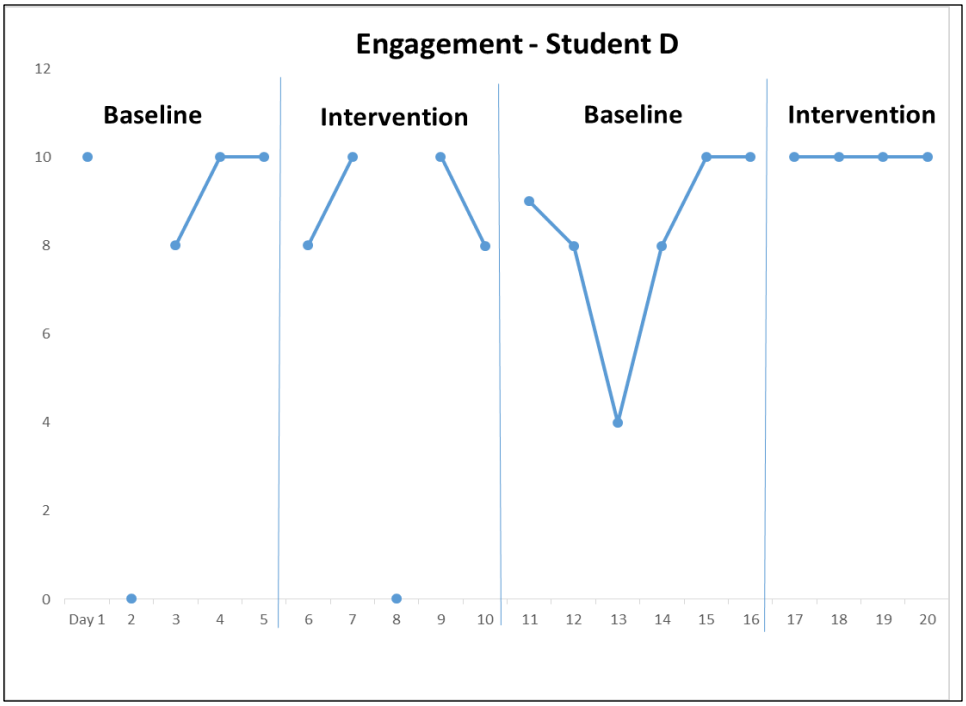

Figure 13. Engagement – Student D

Student E is a thirteen-year-old seventh grade Black female with IEP modifications including: allow extra time for task completion, directions repeated, clarified, or reworded, and read directions allowed. Figure 13 illustrates the academic engagement scores in points for Student E. During the Baseline 1 and Intervention 1, Student E's mean academic engagement score fell slightly from 8.80 to 9.20. During Baseline 2 and Intervention 2, student E's mean academic engagement score fell from 9.17 to 8.66. Student E's mean score rose during the first Intervention and fell during the second.

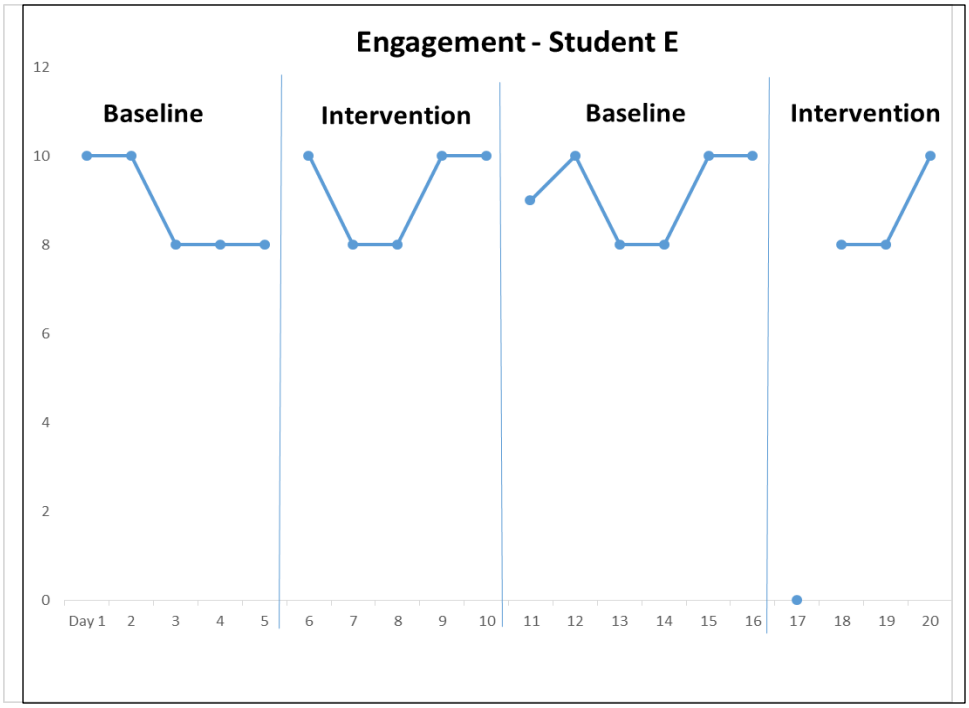

Figure 14. Engagement – Student E

Student F is a thirteen-year-old seventh grade Hispanic female with IEP modifications including: additional time to complete tests/quizzes and break down multi-step tasks into smaller key components. Figure 14 illustrates the academic engagement scores in points for Student F. During the Baseline 1 and Intervention 1, Student F's mean academic engagement score rose slightly from 8.80 to 10.00. During Baseline 2 and Intervention 2, student E's mean academic engagement score rose slightly from 9.40 to 9.50. Student F's mean score consistently rose during both the first and second Interventions.

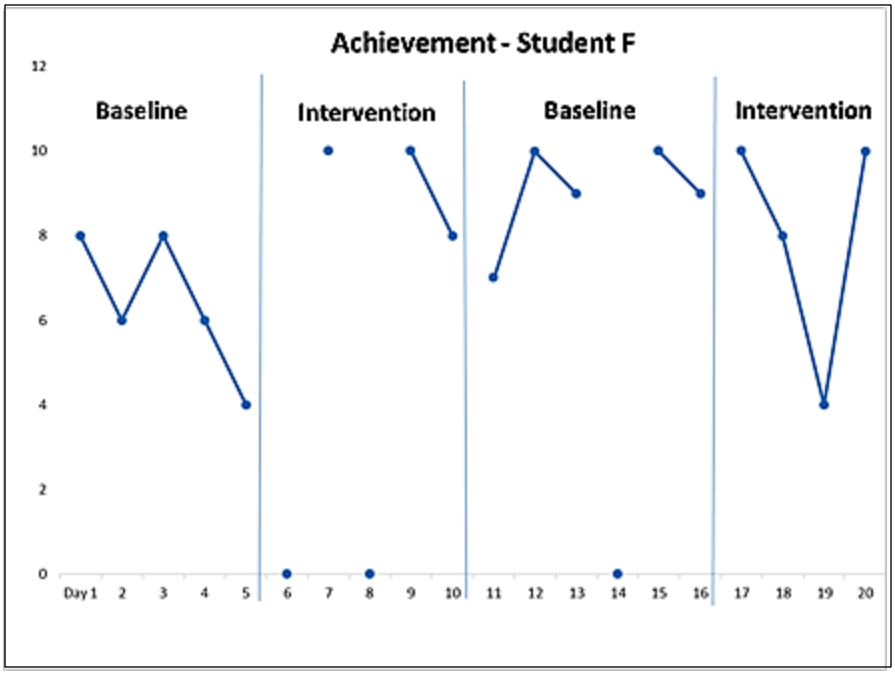

Figure 15. Engagement – Student F

Student G is a fourteen-year-old seventh grade Hispanic male with IEP that states he appears to focus well one-on-one, but there might be Attention Deficit Disorder without Hyperactivity. Figure 15 illustrates the academic engagement scores in points for Student G. During the Baseline 1 and Intervention 1, Student G's mean academic engagement score fell slightly from 8.50 to 7.00. During Baseline 2 and Intervention 2, student G's mean academic engagement score rose slightly from 6.50 to 7.00. Student G's mean score fell during the first Intervention and rose during the second Intervention.

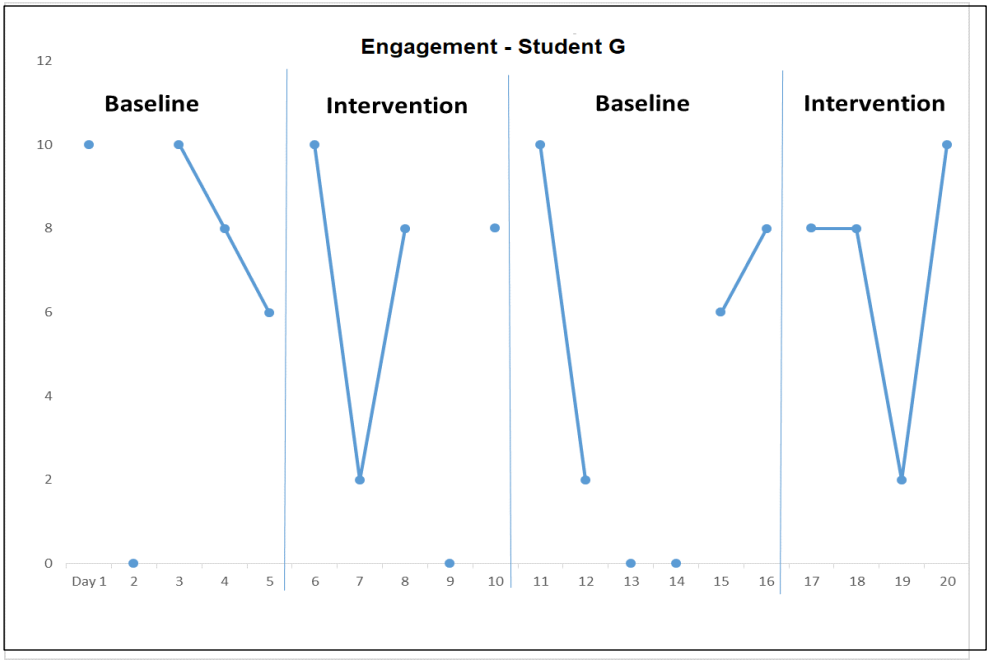

Figure 16. Engagement – Student G

Student Satisfaction

According to the results of the student survey, 57% of students enjoyed using the UDL math menu, while 14.2% disagreed, with 0% strongly disagreeing. Over half the students, 57%, agreed and strongly agreed that they enjoyed using UDL math menus and would like to use them again. No students found the UDL math menus a distraction. Working with partners was the favorite part of UDL math menus for 79.6% of students. Over half, 58% of the students, believed that the UDL math menus kept them on task and that they would rather use technology to stay on task. Less than half of the students reported they would use Quizlet in other classes or would want to share it with others. See Table 4.

Table 4

Student Satisfaction Survey

Statements	Strongly Agree 5 (%)	Agree 4 (%)	Undecided 3 (%)	Disagree 2 (%)	Strongly Disagree 1 (%)
I found the UDL Math Menu easy to use.	43.8	14.2	28.5	14.2	0.0
The UDL Math Menu kept me on task.	14.2	43.8	14.2	14.2	28.5
I would rather use technology to stay on task.	43.8	14.2	14.2	14.2	28.5
The UDL Math Menu was a distraction.	0.0	0.0	43.8	14.2	57.1
I would use the Quizlet application in other classes or settings to help me study.	0.0	14.2	28.5	28.5	43.8
I enjoyed using the UDL Math Menu in class.	28.5	28.5	28.5	14.2	0.0
I am prepared for Math tests and quizzes after completing UDL Math Menu.	14.2	28.5	43.8	0.0	14.2
I would like to share the Quizlet technology with friends and other students.	28.5	14.2	0.0	0.0	57.1
I would like to complete UDL Math Menus again	57.1	28.5	0.0	0.0	14.2

Chapter 5

Discussion

The purpose of the present study was to investigate the effect of UDL math menus on the academic achievement and academic engagement of seventh grade students with disabilities in a resource mathematics classroom. At the conclusion of the study, students completed a survey to determine if they were satisfied with the use of UDL math menus.

Findings

The results of this study show that academic achievement increased during Intervention 1 for all students. When UDL math menus were implemented at first in the classroom, students A, B, C, D, E, F and G, increased from Baseline 1. During Intervention 2, all but one student increased their academic achievement from Baseline 1. Yet, Student D remained consistent in his achievement scores from the Baseline 1 (M = 7.00) to Intervention 2 (M = 6.75). In comparing Intervention 2, to Baseline 2, three students increased their academic achievement. Students A, B, and G increased across both phases from Intervention to Baseline. Student C made great gains with Baseline 1 (M = 7.00) to Intervention 1 (M = 9.60), remaining consistent with Baseline 2 (M = 9.80) and decreasing slightly with Intervention 2 (M = 8.75). The finding that the use of UDL math menus increased student academic achievement corroborates the findings of Hitchcock et al. (2002) and Vitelli (2015) suggesting that a UDL framework in the classroom creates an environment where students with learning disabilities may succeed in spite of the barriers within the curriculum and that UDL-based teaching delivers increased learning outcomes.

The results of this study also show that the weekly mean academic engagement score increased during both Intervention phases for 3 out of 7 students. The dependent variable of

academic engagement for Students B, C, and F was higher during each Intervention phase when compared to each Baseline phase. Students D, E and G increased academic engagement in one Intervention and stayed consistent with their engagement in the other, only declining less than half a point. Kurt et al. (2012) suggests that active engagement and participation follow when the curriculum challenges and allows students to experience success. This study and results align with those findings.

Students B, C and G had the widest range of academic engagement scores across both Baselines and Interventions. Their engagement varied from a Range of 2-10 out of 10 across the entire study. Although their attentiveness was diverse, their academic achievement increased across the study. Students B and G increased academic achievement during both Baselines and Interventions. Student G is the only student in this study with attention deficit disorder. His engagement varied, but his mean academic achievement scores ranged from 3.75 to 5.5 out of 10 during phase 1, and 6 to 7 out of 10 during phase 2.

In comparison, students E and F had the narrowest range of engagement scores across both Baselines and Interventions. Their engagement only varied between 8 and 10 out of 10, yet, neither student showed academic increase from Baseline 2 to Intervention 2. Both students, E and F, tend to generally be attentive, yet the UDL math menus did not prove to be an incentive for an increase in academic success.

All student participants completed a satisfaction survey at the conclusion of the study. The results illustrate that most of the students were satisfied with the use of UDL math menus and agreed or strongly agreed to enjoying them in class. The majority of the class also agreed or strongly agreed that they would like to complete UDL math menus again. The variety offered in the UDL math menus, as expressed by Anderson (2007), not

only provided the content benchmark, but gave the students choice in educational activities, learning process, comfortable setting and method of implementation. The survey conveyed that 85.6% of the students felt working with partners was their favorite part of UDL math menus.

Limitations

This study had several possible limitations. One limitations may have been the subject area of mathematics and the different mathematical concepts presented and taught. Because this study took place in a mathematics classroom, students were taught and/or reviewed a different math lesson every day. The concepts of ratios, proportions, graph interpretation, word problems, linear equations, slope and graphing were all presented over both Baseline and Intervention phases. It is possible that student academic achievement scores on the daily exit tickets were affected by their ability to truly understand each specific concept. Mathematics lends itself to procedural steps where students must demonstrate skills, repeat process and continue individual practice (Friesen, 2008). The daily exit tickets assessed understanding of the day's new material, but also reviewed former knowledge. It is possible that student scores may have been lower the first day a concept was presented and higher the second day after additional practice. There is a possibility that the daily mathematical concept presented may have come easier for one student than for the next.

A second limitation may have been the small number of participants in the study. Only seven seventh graders participated in this study. Therefore, the results of this study cannot be generalized to the entire population of seventh graders in a resource math class. The results of this study may have been limited by the absences of students C, D, E, F and G. Students C and E were both absent for 1 day. Student D missed 2 days. Student F missed

3 days out of the twenty days of data collection. Student G missed 3 days and received in-school suspension another day. The academic achievement data collected was possibly impacted by the mathematical instruction the students missed while absent.

A third limitation may have been the time frame in which the study took place. The study was implemented over a six week period from February 2018 to March 2018. Out of the six weeks, three weeks were four days long due to teacher in-service, an assembly and a holiday. Between interventions, the teacher was absent for three days and three different substitutes covered the class. If the data had been collected for five consecutive days for four consecutive weeks, the data may have been stronger.

Implications and Recommendations

Though this study has its limitations, the data does suggest that the use of UDL math menus helps to increase the academic achievement and academic engagement of students in a seventh grade resource room mathematics classroom. UDL math menus were found to increase the weekly mean academic score for each and every student in this study during one or both interventions. This corroborates with prior studies that have suggested that the implementation of UDL guidelines address the characteristics of many students with disabilities: lack of engagement, off-task behavior and poor academic outcomes (Cook et al., 2017; Hitchcock et al, 2002; Lowrey et al, 2017; Vitelli, 2015). It is recommended to use UDL math menus as a teaching method in the classroom for students with disabilities.

The present study also found that a majority of the class (58%) stated that they would prefer using technology to stay on task. Zascavage and Winterman (2009) found that incorporating technology into the classroom would vary methods and options for students. UDL math menus offered different technology supporting multiple means, enhancing

assessment and instruction, as suggested by Basham et al., (2010). It was observable during this study, when given the option, most students chose first a technology item available on the UDL math menu presented. To assist with classroom management and focus, all students began daily menu work with a technology option of their choice and a given time limit or score requirement. This procedure got all students focused immediately and eliminated down time.

Conclusions

This study was successful in that it slightly increased the academic achievement and academic engagement among most students in a seventh grade resource mathematics classroom. The study also confirmed that students were satisfied with the use of UDL math menus. UDL math menus are another method teachers can effectively use in the classroom. It is a practical way to create interest and differentiation.

Recommendations for future research include conducting the study with a larger number of student participants, as well as exploring the implementation of more varied technology in the menu options on student outcomes.

References

Anderson, Kelly M., (2007). Differentiating instruction to include all students. Tips for Teaching, Heldref Publications.

Basham, J. D., Israel, M., Graden, J., Poth, R., & Winston, M. (2010). A comprehensive approach to RTI: embedding universal design for learning and technology. *Learning Disability Quarterly, 33*(4), 243-255. doi:10.1177/073194871003300403.

Botzakis, S., sbotzaki@utk.edu. (2017). Websites and apps for teaching and learning mathematics. *Journal of Adolescent & Adult Literacy, 60*(5), 597-600. doi:10.1002/jaal.618.

Burns, M. (2016). Using math menus. *Educational Leadership, 74*(2), 40-44.

Cook, S. C., Rao, K., & Collins, L. (2017). Self-monitoring Interventions for students with EBD: applying UDL to a research-based practice. *Beyond Behavior, 26*(1), 19-27. doi:10.1177/1074295617694407.

Courey, S. J., Tappe, P., Siker, J., & LePage, P. (2013). Improved lesson planning with universal design for learning (UDL). *Teacher Education and Special Education, 36*(1), 7-27. doi:10.1177/0888406412446178.

Cuenca-Carlino, Y., Freeman-Green, S., Stephenson, G. W., & Hauth, C. (2016). Self-regulated strategy development instruction for teaching multi-step equations to middle school students struggling in math. *The Journal of Special Education, 50*(2), 75-85. doi:10.1177/0022466915622021.

Friesen, S. (2008). Raising the floor and lifting the ceiling: math for all. *Education Canada, 48*(5), 50-54.

Harlen, W., & Crick, R. D. (2003). Testing and motivation for learning. Assessment in Education: Principles, Policy & Practice, 10, 169-207.

Hitchcock, C., Meyer, A., & Rose, D. (2002). Providing new access to the general curriculum: universal design for learning. *Teaching Exceptional Children, 35*(2), 8-17.

Hume, K., Boyd, B. A., Hamm, J. V., & Kucharczyk, S. (2014). Supporting independence in adolescents on the autism spectrum. *Remedial and Special Education, 35*(2), 102-113. doi:10.1177/0741932513514617.

Little, M. E. (2009). Teaching mathematics: issues and solutions. *TEACHING Exceptional Children Plus, 6*(1).

Logan, Brenda. (2009). Examining differentiated instruction: teachers respond. Armstrong Atlantic State University. 1-14.

Koepke, Kathleen Mann, & Miller, Brett. (2013). At the intersection of math and reading disabilities: introduction to the special issue. Journal of Learning Disabilities. 46 (6), 483-489.

Kurz, Alexander, Talapatra, Devadrita, & Roach, Andrew T. (2012). Meeting the curriculum challenges of inclusion assessment: the role of alignment, opportunity to learn, and student engagement. International Journal of Disability, Development and Education. Vol. 59, No. 1. 37- 52.

McTighe, J., & Brown, J.L. (2004). Differentiated instruction and educational standards: is détente possible? Theory into Practice, 44(3), 234-244.

Marino, Matthew T., Gotch, Chad M., Israel, Maya, Vasquez III, Elazar. Basham, James D., Becht, Kathleen. (2013). UDL in the middle school science classroom: can video games and alternative text heighten engagement and learning for students with learning disabilities. Learning Disability Quarterly. DOI 10.1177/0731948713503963.

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A review of research on universal design educational models. Remedial and Special Education, 35, 153-166. Doi 10. 1177/0741932513518980.

Scigliano, Deborah, & Hipsky, Shellie. (2010). 3 ring circus of differentiated instruction. Kappa Delta Pi Record. Winter.

Shin, M., & Bryant, D. P. (2017). Improving the fraction word problem solving of students with mathematics learning disabilities. *Remedial and Special Education, 38*(2), 76-86. doi:10.1177/0741932516669052.

Smith Canter, Lora Lee1, smithcanteerl@ecu.edu, King, L. H. 1., Williams, J. B. 1., Metcalf, D., & Myrick Potts, K. R. (2017). Evaluating pedagogy and practice of universal design for learning in public schools. *Exceptionality Education International, 27*(1), 1-16.

Steele, M. M., & Steele, J. W. (2003). Teaching algebra to students with learning disabilities. Mathematics Teacher, 96, 622-624.

Thomas, C. N., Van Garderen, D., Scheuermann, A., & Lee, E. J. (2015). Applying a universal design for learning framework to mediate the language demands of mathematics. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 31*(3), 207-234. doi:10.1080/10573569.2015.1030988.

Vitelli, E. M. (2015). Universal design for learning. *J Spec Educ Technol, 30*(3), 166-178. doi:10.1177/0162643415618931.

Zascavage, V., and Winterman, K.G. (2009). What middle-school educators should know about assistive technology and universal design for learning. *Middle School Journal,* 40(4), 46-52.