ACHIEVEMENT AND SELF-EFFICACY OF TWICE-EXCEPTIONAL (2E) STUDENTS USING MOBILE APPLICATIONS

A Dissertation Presented to the
Faculty of the College of Education
University of Houston

In Partial Fulfillment
of the Requirements for the Degree

Doctor of Education

by

Josephine J. Salinas

December 2016

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Abstract

Twice-exceptional (2e) students have exceptional abilities and disabilities, which present challenges for educators to serve their needs in schools. Their abilities may overshadow their disabilities, thus camouflaging their disability. Conversely, their disabilities may overshadow their abilities, thus camouflaging their ability; each may neutralize the other so that neither is addressed. The purpose of the study was to explore perceptions of teachers and licensed clinicians working with 2e students when using mathematics mobile applications to address achievement and self-efficacy. For this study, IXL Math, a mathematics mobile device application-based subscription site, was used to support achievement and self-efficacy of 2e students. IXL Math was chosen for multiple reasons including popularity, real-time analytics for teachers, and alignment to state standards.

The four-week study examined pre- and post-descriptive statistics from Patterns of Adaptive Learning to evaluate self-efficacy, Adaptive Diagnostic Assessment of Mathematics (ADAM) to evaluate achievement, and usage reports from IXL Math. Classroom observations were used to build a foundation of code and theory, and interviews with teachers and licensed clinicians were used to explore their perceptions and interpretations from the coding analysis. The research question explored the extent to which mobile applications affect achievement and self-efficacy among 2e students. Conceptually, this study was framed within a social learning theory due to the interconnectedness of the

classroom environment, perceptions in learning, and the performance outcomes. Data collected through classroom observations, interviews, standardized achievement scores, usage reports, and self-assessments were used to evaluate the research question. Participants were five students, two teachers, and two licensed clinicians from a small private school. A single case-study research design was used to explore patterns, themes, and relationships in the data. The results of the study explored the achievement and self-efficacy of 2e students using IXL Math, however, further exploration is needed of mobile device applications to support 2e students. The teacher training, clinician support, and small teacher-to-student ratios appeared to be helpful for students struggling to regulate their emotions while using IXL Math. The novelty of IXL Math and the extrinsic motivations of reward boards and SmartScore appeared to outweigh the intrinsic motivation of learning as the reward. Further recommendations involve more in depth critique of mobile device applications to support achievement and self-efficacy of 2e students.

Keywords: mobile device application, special education, gifted, disabilities, achievement, self-efficacy, twice-exceptional

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Chapter I

Introduction

In gifted and special education, an underserved population exists, known as twice exceptional (2e), gifted and with disabilities. Approximately three to five million gifted students are served in K-12 in the United States school systems (National Assocation for Gifted Children, 2016) and 6.5 million students who are 3-21 years old and served in the special education programs in public schools (Kena, McFarland, de Brey, Musu-Gillette, Wang, Zhang, Rathbun, Wilkinson-Flicker, Diliberti, Barmer, Mann, and Velez 2016). Although no agency or organization collects data regarding 2e students, an estimated 6% of students served under the Individuals with Disability Education Act (IDEA) are also 2e gifted students (National Association for Gifted Children, 2016). To meet the needs of 2e students, effective teachers and the collaboration of experts must be patient and understanding. When in place, the potential to support the academic achievement and self-efficacy of 2e students may be met.

I have been a classroom teacher, administrator, and now the founder of a special education school. In more than a decade of working in special education, I have encountered many exceptional students. One exceptional student motivates me in my research, training, and career. This student came from a local public school in my final year as a classroom teacher in a private school. Like many other students, he entered my class with his head hanging low. When he left public school, his last desk was situated underneath the auditorium bleachers. He spent all day in the auditorium with no opportunity to socialize because his

teachers and administration had no solution for supporting his academic, social, or emotional development.

His family did not neglect him, but I could have easily perceived him as a neglected child. His classmates wondered about him. “Ms. Jeanette, why does he wear the same clothes every day?” “What is the stuff coming out of his ears?” “Why does he not talk?” Why does he not eat?” He wore the same clothes, had earwax crusted outside of his ears, did not talk to anyone, and did not eat lunch.

I was worried because my attempts to support the student to be an engaging member of the classroom did not work. The trauma the student experienced created a mistrust of educators, and a longer time was needed to build a relationship based on trust and security. It took months of small steps to help the student navigate through his past school experiences and anxieties before reaching him academically or socially. A tidbit of information his parents shared with me about his interests and strengths would eventually come into play, but I had to first focus on creating a safe space for him to be himself. After months of working with him and his parents, he had grown to trust that he was safe enough to come out of his chrysalis.

The isolated student with his head on his desk turned into a fluttering spirit of joy. He was finally a part of the classroom experience and no longer had to protect himself. My experiences with this student and many more exceptional students have helped me realize that education should not primarily be formulated based on my expectations. Instead, teachers should be flexible and understand that the progress of each student cannot always be as laid out during in-service

meetings or lesson planning.

Statement of Problem

Although 2e students can be served by GATE (Gifted and Talented Education) programs and through IDEA when identified, no uniform program meets the needs of 2e students (Trail, 2009). The 13 categories of disabilities defined by IDEA in combination with the various facets of gifts and talents of 2e students limit specifying a "one size fits all" instructional method to meet their needs (Reis, Baum, & Burke, 2014). Researchers agree that utilizing personalized and differentiated approaches to learning can help 2e students succeed in the classroom (Baum, Owens, & Dixon, 1991; Moody, 2015).

Lack of training and experience can lead to challenges for educators working with 2e students (Foley-Nicpon et al., 2011). Adaptive technology, in conjunction with practical strategies, might offer an effective method for educators to support 2e students (Willard-Holt, Weber, Morrison, & Horgan, 2013). Technology options, like mobile math applications, should affect the learning of 2e students by helping students to focus on abilities while minimizing the child's disabilities (Trail, 2009).

Purpose

In this study, students used IXL Math, a mathematics mobile application, for four weeks during mathematics class. The adaptive features of the IXL Math presented teachers with an opportunity to support a classroom of students at various levels of math achievement. The first purpose was to examine the perceptions of experts and 2e students and the achievement of students using IXL

Math in an attempt to understand their experiences. The second purpose was to understand strategies used in the classroom to support students to cope with social and emotional struggles during the use of IXL Math.

IXL Math's analytic tools have the potential to provide insight for teachers to support the learning experiences of students. IXL Math usage reports provide educators access to real-time performance statistics. Usage reports filters include subject, grade level, and content area. The reports display skills practiced and can be magnified to show related sample problems. Educators can further monitor students with access to time spent on each problem. IXL Math provides instant feedback supporting the student to correct errors (Longnecker, 2014), which helps 2e students who often require consistent teacher feedback and redirection during tasks (National Education Association, 2006).

Self-efficacy is defined as the belief in one's capable behaviors or actions to produce an outcome (Bandara, 1986). Self-efficacy is a critical element in the effort exerted by students during an academic activity (Zimmerman, 2000). Parjares and Graham's (1999) research discovered a positive correlation between self-efficacy and math achievement in students. Furthermore, a suggested positive relationship may exist between self-efficacy and achievement in general (Pintrich and De Groot, 1990). Gifted students are commonly attributed with higher self-efficacy and are more likely to be conscious of their abilities (Trail, 2009), while students identified with a disability often are described with low self-efficacy and are not confident about their skills or abilities (Baldwin, 1999). 2e students commonly struggle with self-efficacy (Rutter, 1987), and the use of mobile

applications has shown to increase self-efficacy and achievement (Sivin-Kachala, 1998).

The 2e population often struggles when using the traditional curriculum standards and situations that teach to the test and require learning by rote, repetition, and drill (Trail, 2009). Studying the effects of using IXL Math can add to the understanding of the use of a mobile application in classrooms with 2e students for future considerations for math curriculum to support achievement and self-efficacy. This study has the potential to equip teachers with strategies to support achievement and self-efficacy. Hacket and Betz (1989) suggest that evaluating self-efficacy is as important as monitoring academic achievement because self-efficacy is important for students to succeed and perform in the classroom (Schunk, 1989). Twice-exceptional (2e) students experience struggles with academic achievement until they can develop confidence and self-efficacy (Silverman, 2002).

Research Question

> How does the use of a mathematics mobile device application affect achievement and perceptions of self-efficacy of 2e students, and the perceptions of teachers and clinicians who support 2e students?

Significance of Study

The concept of students that have disabilities and gifted is not new to education (Trail, 2009). The existing research is based on identification, needs, and strategies for assisting 2e students rather than efficacy (Foley-Nicpon, Assouline, & Colangelo, 2013). Twice-exceptional (2e) students struggle with

self-efficacy (National Education Association, 2006), and IXL Math has the potential to support social and emotional needs of 2e students impacting self-efficacy and academic achievement (Longnecker, 2014).

Definitions

Academic achievement: The extent to which an educational outcome or goal *is* met (Zimmerman, 1990).

Individualized Instruction: Teaching that supports academic, social, and emotional learning. Student progresses at their own rates, and instructors use methods of instruction preferred by each student (Arnell, 2014).

IXL Math: A membership-based math site that offers each student individual learning plans set by the teacher to learn, practice, and master state mathematics standards and concepts.

Mobile application instruction: Classroom instruction using a mobile device, such as a computer, iPad, or other tablet (Arnell, 2014).

Mobile learning: Educational materials, instruction, and other academic activity accessed in any place or time through mobile device communication (Arrigo, Kukulska-Hulme, Arnedillo-Sánchez, & Kismihok, 2012).

School: The students enrolled at the school, along with the clinicians and teachers that work with those students.

Self-efficacy: The belief in one's capable behaviors or actions to produce an outcome (Bandara, 1986).

Student engagement: A student's attention, curiosity, interest and motivation during instruction or during learning, which can be attributed to the

motivation to persevere through learning situations (Korobova & Starobin, 2015).

Traditional Math Classroom: A classroom in which the class is taught the same lesson directly by a teacher using a textbook and other traditional materials (Devlin, Feldhaus, & Bentrem, 2013).

Twice-exceptional (2e) students: Individuals with evidence of exceptional ability and disability, which results in unique circumstances. Their exceptional ability may dominate, hiding their disability; their disability may dominate, hiding their exceptional ability; each may mask the other so that neither is recognized or addressed (Council for Exceptional Children, 2016).

Summary

Although previous research has identified a correlation between mobile application-based instruction with achievement and self-efficacy (Trail, 2009), additional research is needed to discover effective mobile device application-based math instruction for 2e students. The purpose of this present study was to investigate the following question:

> How does the use of a mathematics mobile device application affect achievement and perceptions of self-efficacy of 2e students, and the perceptions of teachers and clinicians who support 2e students?

Chapter II

Review of Literature

> You can see them, you can hear them, and sometimes you can "feel" them—these young gifted children. The ways they differ from their chronological peers are observable to those who know how to look. Yet, one or two years later they become invisible. What is it that happens between the time they enter kindergarten and leave first grade? What is it that turns enthusiasm to apathy, and apathy to hostility by the fifth and sixth grades? (Gallagher & Kinney, 1974, p. 16)

The developments in the field of gifted education have led to the identification of students who are gifted and have disabilities. The complexity of gifts and disabilities has created a diverse population of students with social and emotional issues (Lovecky, 2004). The key factor in supporting 2e students to develop social and emotional skills is to understand their struggles in self-concept, self-esteem, and self-efficacy (Song & Porath, 2011). While meeting the needs of 2e students can be complex, prior research has revealed that technology can help to meet the academic needs of these students (Baum, 2012; Foley-Nicpon, Assouline, & Colangelo, 2013; Robinson, 1999).

2e as Gifted with Disabilities

The multiple exceptionalities of students complicate the task of meeting the needs of 2e students (Foley-Nicpon et al., 2011). Foley-Nicpon, Assouline, & Colangelo's (2013) found that educators of gifted students excelled more often than educators of students who are not identified as gifted when working with 2e children because educators of gifted students are familiar with the services and

strategies for working with the gifts and talents of 2e students. Although gifted educators have the skill set to support the gifts and talents of 2e children, they usually lack the skillset to help students connect the dots between classroom content and the application of it (Foley-Nicpon et al., 2013). Teachers, with or without formal training in gifted and/or special education programming, can benefit from receiving support and effective strategies from teachers in another gifted program, special education educators, specialists and counselors (Baum et al., 1991; Colangelo & Davis, 2013; Foley-Nicpon et al., 2013; Van Tassal-Baska, 1991). Only with adequate support and training can educators understand and adequately support the emotional frustration of children who often end up misunderstood because of failure to assist these students in achieving their expectations and the expectations of others (Nielsen & Higgins, 2005).

A student who is recognized as 2e is gifted/talented and has a disability (Foley-Nicpon, Assouline, & Colangelo, 2013). The Association for the Gifted, a division of the Council for Exceptional Children (CEC-TAG), initially identified a specific group of gifted students as gifted-handicapped in the 1970s (Maker & Grossi, 1985). Leading with the term gifted was important for John Grossi of the CEC-TAG, who wanted to put forth the ability in the label first an attempt to develop awareness of the potential for children (Maker & Grosser, 1985). The population later came to be known as 2e by Whitmore (1980) and Maker (Udall & Maker, 1983), and the awareness of parents, educators, specialists, and therapists began to move past the decades of misunderstanding the needs of the 2e

community (Whitmore & Maker, 1985). The 2e population has evolved into a central component of gifted education ((Foley-Nicpon, et al, 2013).

The 2004 amendment of the Individuals with Disability Education Act (IDEA) unveiled a law mandating education meet the needs of all students (Foley-Nicpon et al., 2011). Under the IDEA, eligible students can receive services for 13 protected disabilities (U.S. Department of Education, 2004). Although IDEA can be used to serve identified children, the complex nature of gifts and disabilities creates a challenging task for educators and other professionals to support and develop classroom strategies (Kalbfleisch, 2013). Once identified with disabilities, a student qualifies for the services under the IDEA; however, giftedness is not identified under IDEA, and too many students go unidentified (Whitmore & Maker, 1985). Furthermore, the masking effect of abilities and disabilities leads to countless students not being identified (Foley-Nicpon, M., Assouline, S. G., & Colangelo, N. (2013). The inconsistencies of identification and supportive classroom strategies result in a need for educators, clinicians, and other experts in special education to recognize the need to support 2e students (Foley-Nicpon, et al., 2013).

Struggles of 2e Students

The complexity of 2e students often creates confusion for teachers on how to support gifted students and their simultaneous disabilities (Song & Porath, 2011). Twice-exceptional (2e) students exhibit high academic potential, high IQ scores, creativity, strong beliefs about learning, and leadership and show evidence of a disability defined by a state or federal standard (Baum, 2012). Twice-

exceptional (2e) students have a common struggle of dealing with low self-esteem, which often shows itself as behavior in the classroom marked by excessive crying, escaping into fantasy, and an inability to take ownership for disruptive behaviors (Lovecky, 2004). Yssel, N., Prater, & Smith (2010) claimed the trauma of feeling left out paired with the failure to meet the expectations of others causes low self-esteem and challenges in the classroom.

In addition to struggling with self-esteem, 2e students struggle to regulate socially and emotionally (Baum, 2012). Self-regulation can be defined as the ability to maintain impulse control, both stopping a response or initiating a response when needed (Kanevsky, L, 2011). Self-regulation, also a component of one's executive functioning, is typically delayed in 2e students when compared to intelligence (Baum, 2012). The difficulty for educators working with 2e students arises from the ability of 2e students to intellectualize advanced concepts while being hindered by the struggle to plan, organize, prioritize and self-regulate (Trail, 2000).

Categories of 2e Students

Baum (1989) identified three categories of 2e students. The first category is when the giftedness overshadows an undiagnosed disability. An example might be a student with an above average vocabulary but who is a poor speller. The second category is when a disability overshadows an undiagnosed giftedness. This could happen if a student has anxiety and exhibits challenging behaviors that interfere with instruction in the classroom. The third category is when giftedness and disability neutralize one another leaving neither identified. This type of

student typically ends up in a regular education classroom with no modifications or accommodations for gifts, talents, or disabilities.

Related Technology Reform in the United States

The rapid rate of technology advancement has forced legislators and researchers to figure out the best practices for classroom use (Culp, Honey, & Mandinach, 2005). The No Child Left Behind Act of 2001 (NCLB) signaled a beginning of an era of a nation working together to make sure all students have access to technology (Klingner, Ahwee, Pilonieta, Menendez, 2003). A problem was arising with the integration of classroom technology because the infrastructure to support technology use was not always affordable to schools or school districts. This epidemic has left many devices unused (Knezek & Christensen, 2016). The NCLB underscored initiatives involving public-private partnerships to build an infrastructure to integrate technology (Klingner, Ahwee, Pilonieta, Menendez, 2003).

The U.S. Department of Education highlighted the importance of classroom technology through the Enhancing Education Through Technology Act of 2001 (E2T2). E2T2 identified technology as a means to improve achievement among students, emphasizing the development of research to create approaches for the use of classroom technology (Lovett et al., 2001). Between the years of 2002 and 2008, billions of dollars were designated to provide schools with funds to procure classroom technology. The policy also allocated money to research to measure the effects of implementing classroom technology (Lovett et al., 2001). The goal was to “improve student academic achievement through the use of

technology in elementary and secondary schools" (Lovett et al., 2001). Another goal was to not only provide funding but establish plans for studying how to best use technology in the classrooms. Funding was dispersed to school systems via applications by school systems for competitive grants.

The National Education Technology Plan of 2016 (NETP), "Future Ready Learning: Reimagining the Role of Technology in Education," promotes active learning and equity to ensure learning is possible everywhere (U.S. Department of Education, 2016). This initiative encourages using, a student-centered classroom that allows students to direct their learning and utilize the flexibility of technology to accommodate experiences in and outside the classroom. This approach is instead of a traditional classroom where the teacher leads learning. The NETP 2016 emphasizes that connecting home experiences of students who have the belief that technology is an essential element of life to classroom success can support students' perceptions of the importance of using technology in the classroom (National Education Association, 2012). Bridging the students' home experiences with classroom use allows students to tap into on their confidence of using technology to empower themselves to increase achievement and self-efficacy in the classroom (National Education Association, 2012; Zimmerman, 1990).

NETP 2016 states that educators are on the ground floor of policy implementation, and teachers and administrators have to be part of the plan (U.S. Department of Education, 2016). The successful implementation of technology not only relies on the student but also educators and administrators have to be

confident about their approaches for utilizing tools for learning (U.S. Department of Education, 2016). Educators are encouraged to step outside of their classroom walls to collaborate with other educators, specialists, and parents to deliver lessons to strengthen the classroom environment. As the era of classroom technology evolves, educators have an opportunity to build a collection of lessons to meet the needs of all students (U.S. Department of Education, 2007). The NETP 2016 aligns with the plan outlined in the Every Student Succeeds Act of 2015 to support educators individualize learning and increase access (U.S. Department of Education, 2016).

The International Society for Technology in Education (ISTE) was founded in 1979 to advocate for educators and establish professional development practices in using technology in teaching and learning (ISTE, 2016). ISTE has advocated for technology integration programs to underserved areas, enabling educators to support students by improving learning practices. The constant demand for digital awareness motivated ISTE to establish the National Education Technology Standards (NETS), now referred to as the ISTE Standards for Students (ISTE, 2016). The standards provide efficient goals to work toward for educators, administrators, policymakers, and other professionals to provide equitable and accessible learning experiences for all students (ISTE, 2016).

As the access to technology and best practices expands, the opportunity to accommodate all learners also develops. Even with the hope that technology will enhance the learning environment, the challenge continues to fund and support access for all students. Policy and research professionals must continue to build

upon the existing body of knowledge and practices to keep up with the innovative tools of the classroom.

Mobile Device Applications

The constant updates of mobile device applications continue to add new instructional technologies in the classroom, and there are promising results from the use of mobile devices in special education (Draper-Rodríguez, 2014). Mobile device applications allow for differentiation of instruction and the use of applications to accommodate students' varying strengths and weaknesses (Willard-Holt, Weber, Morrison, & Horgan, 2013). Accommodating 2e students' abilities and disabilities (National Education Association, 2006) is both important and manageable by using mobile device applications (Willard-Holt et al., 2013). Mobile device applications illustrate, narrate (Willard-Holt et al., 2013), and give students options to show their comprehension. Furthermore, (Knezek & Christensen, 2016). Willard-Holt et al. (2013) found that personalizing assessments for 2e students accommodate a student's disabilities; however, they found that teachers were reluctant to spend the time to implement supportive measures. 2e students exhibit potential for high academic potential, and mobile devices can be used to support their ability is when the teachers implement supportive strategies (Baum, 2012).

Learning Theories

Twice-exceptional (2e) students need support learning social and emotional skills (Baum, 2012) when using mobile device applications; therefore, this section discusses performance evaluation, self-concept, and self- efficacy

which support the development of those skills. Social constructivists identified performance evaluation as a motivating factor for the development of positive self-perception and self-efficacy (Schunk, 2012). The structure and organization of the classroom alter the learning environment and student perceptions of their learning experiences (Zimmerman, 1990). A classroom that is organized using a unidimensional classroom environment where publicized grades and uniform assignments are typical (Schunk, 2012) can create challenging situations because of the common characteristic of low self-efficacy (National Education Association, 2006). Performance evaluation of 2e students is best set in a multidimensional classroom allowing for differentiation of learning and individualized grading without the social comparison (Schunk, 2012; Zimmerman & Martinez-Pons, 1990). The multidimensional classroom model can be supported by the use of mobile device applications because the teacher's use of mobile device applications supports flexibility when creating lesson plans and individualizing lessons (Schunk, 2012).

Social Learning Theory

At the core of Bandura's (1986) social learning theory is the interconnected relationship among environment, personal perspectives, and behavior (Zimmerman, 1990). Social learning rests on a learning curve of which involves consequences based on student behavior or performance (Bandura, 1986). Therefore, the implications of performance or behavior that are perceived to be successful are preserved while those that are seen to be unsuccessful are

rejected. A combination of effort and repetition to explore performances and behaviors that may lead to successes and failures (Shirk and Renouf, 1992).

Self-efficacy is an important measure for determining achievement (Bandura, 1986; Pintrich & De Groot, 1990; Schunk, 1991). A student's self-efficacy does not solely rely on his or her perception to obtain information, develop skills, and master concepts (Schunk, 1991). A student may feel motivated to push past challenging situations when a more developed sense of self-efficacy exists. Bandura (1986) posited that prior experiences, observations of others in similar circumstances, physical cues, and responses from others in the environment will develop a student's assessment of efficacy as he or she progresses through new learning experiences.

The development of self-efficacy. Self-efficacy evolves through childhood development. The initial stage of self-efficacy is marked by unrealistic expectations of the self and misjudgment of ability (Shirk & Renouf, 1992). Children developing into elementary age begin to discover the balance of ability and realistic expectations (Schunk, 1989). 2e students struggle socially and emotionally and are often delayed in developing realistic expectations (Baum, 2012). Bandura (1995) argues that the role of efficacy is crucial in developing intellectual skills to manage academic achievement. Furthermore, for students who have been unsuccessful in school, who internalize failure, and who doubt their learning potential, the development of self-efficacy is critical to support their future success in school and life (Bandura, 1995).

Sources of self-efficacy. Bandura (1982) described four sources of self-

efficacy, including enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological cues. The enactive mastery experiences come from past successes and failures. While successes support the development of self-efficacy, it is best that successes do not come easily, because successes will be expected without effort. Another consequence of easily earned successes is the likelihood of being easily discouraged when failures occur. Bandura (1985) found mastery experiences are the most important source of self-efficacy when persistence through failure occurs, even when individuals are faced with challenging situations.

Vicarious experiences are modeled behaviors leading to beliefs in abilities of observers (Bandura, 1995). When observers are uncertain of their own abilities and knowledge, modeled behavior allows a heightened sense of ability, and perseverance can increase. According to Schunk and Hanson (1985), peer models were found to be more supportive of increasing self-efficacy than adult-teacher models. However, they did find that having a teacher as a model is better than not having any model to observe.

Verbal persuasion, a type of social persuasion, can increase self-efficacy when performance accomplishment is followed by verbal feedback (Bandura, 1986). The source providing verbal persuasion must be someone with whom the observer has established trust and believes will provide trustworthy input. When the observer does not trust the source or the source's feedback, the observer will likely discredit the feedback. Positive verbal persuasion can support sustained

effort and motivation, but supporting efficacy by only verbal persuasion is difficult (Bandura, 1982).

Physiological cues occur when physiological and emotional states are used to judge capability. Emotional states can be perceived differently. For instance, stress can be viewed in different ways depending on self-efficacy (Bandura, 1995). The four sources of self-efficacy are evaluated leading to an individual's choice of tasks and avoidance of activities that are not viewed as being doable (Bandura, 1977). The perception of efficacy is a factor in the amount of time and effort exerted for an activity, especially when faced with a challenge. During challenging situations, Schunk (1989) asserted that individuals who believe they are capable will exert more time and effort than individuals who do not perceive themselves as capable. The study explored the experiences of 2e students that struggled with completing IXL Math activities when faced with incorrect answers and feeling as if they were not able to accomplish the task.

Determining capability rests on much more than performance; therefore, one must account for other related abilities and disabilities impacting efficacy (Williams, Kinney, & Falbo, 1989). Other factors include ability and non-ability, the variation of perceptual factors through a performed activity, the degree to which effort is exerted, the amount and type of external support received, the environment during the performance, and the method taken to organize and construct the experiences. When self-efficacy and past performances are used as predictors in inconsistent circumstances, often efficacy is a more reliable predictor (Schunk, 2016).

Implications: Mathematics Achievement and Self-Concept

Twice-exceptional (2e) students frequently struggle with focus and require consistent teacher redirection and feedback (National Education Association, 2006). Mobile devices and applications provided not only opportunities to engage students but also to support student success while developing skills for self-regulation and determination as well (Cumming & Draper-Rodriguez, 2013). Mobile device use can increase assignment completion increases with mobile device use, and they supported the use of technology to increase assignment completion and enhance student self-concept (O'Malley, Jenkins, Wesley, Donehower, Rabuck, and Lewis, 2013).

Many mathematics mobile device applications provide instant feedback and support the student in correcting errors (National Education Association, 2006). Another important attribute of mathematics mobile device applications, like IXL Learning, is that they provide immediate response to correct answers (Haydon, Hawkins, Denune, Kimener, McCoy, & Basham, 2012). 2e students struggle with social and emotional issues like the inability to identify self-worth (National Education Association, 2006), and the mobile device application's instant feedback reinforces the student's ability and supports the work of developing the student's self-concept (Haydon, Hawkins, Denune, Kimener, McCoy, & Basham, 2012).

Instructional Tools to Increase Task Achievement

Models of technology integration fall into two categories: (1) models that focus on removing barriers that prevent teachers from completely implementing

information technologies into learning experiences, and (2) models that focus on acquiring skills to teach with technology (Knezek & Christensen, 2016). Technology can be used to accommodate a student's disability to increase achievement (Baum, 1989; Coleman, 2001; Foley-Nicpon et al., 2011). O'Malley et al., (2014) conducted a single-case study of ten moderate to severe autistic seventh- and eighth-grade students using a mobile device instruction intervention for basic a math class. The single case study design used an ABAB treatment to compare the effects of facilitating similar academic content using worksheets versus mobile devices on academic performance and student engagement. Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005) suggested that the single-case study subject design allowed for the individual unit of concern, active intervention, and practical procedures, which is important in special education because this tends to be a problem-solving field where educators are constantly faced with new challenges. The study indicated that the mobile device supported increased academic independence during assignments and increased math performance more than the use of traditional mathematics worksheets.

A single subject study by Rubenstein, Siegle, Reis, Mccoach, and Burton (2012) was the first in the field of gifted education. The study focused on the underachievement of gifted students and revealed the difficulty in working with underachieving students. The Rubenstein et al. (2012) study regarding gifted students was significant because the research explored low self-concept related to the expectations placed on students by family and educators. The research

examined the motivation of gifted students and concluded that gifted students are more likely to be motivated when they perceive the lesson or skill as significant. Learners with self-efficacy were also more prone to develop self-regulation skills learning to set goals such as selecting learning strategies, monitoring performance, and reflecting on their learning process (Rubenstein et al., 2012). They will inevitably develop self-regulatory skills in the classroom and life (Ramdass & Zimmerman, 2011).

Addressing the social and emotional needs of 2e students is critical to supporting academic success (National Education Association, 2006). 2e students are sensitive to their failures; and as perceived failures mount, they begin to identify with those inadequate feelings that affect academic success (Baum, 1989). Barber and Mueller (2011) conducted a national analysis of 12,105 students in grades 7–12 grouped as gifted, students with learning disabilities, students not identified as gifted or with learning disabilities, and 2e students. The study revealed that 2e students tended to have lower social and self-perceptions compared to gifted students and aligned closer to students with learning disabilities than gifted students (Barber & Mueller, 2011). Interview questions were designed to evaluate social and self-perceptions based on the students' perceptions of school belonging, relationships with parents, and self-concept. The parent-child relationship suffers due to expectations based on their child's gifts combined with the failures that arise in school due to their child's disability, which affects self-concept, self-perception, and influences the child's success in school and life (Coleman, 2001).

Social Skills in the School Environment

The multiple exceptionalities in conjunction with the multitude of negative experiences (including misdiagnosis and placement in self-contained classrooms) can lead to negative perceptions of 2e children creating difficulty with peers and teach in school (Rubenstein et al., 2013). The goal of mastering social skills will enable students to participate in and contribute to the school and social environment impacting their academic learning (Brigman, Webb, & Campbell, 2007). Social skills in the school environment encompass communication, managing conflicts, regulating frustration, and expressing feelings appropriately and at appropriate times (Charney, 2002). Social skills are the basis for following directions, developing an internal system of reward for experiences in life and at school, initiating and maintaining relationships with others, navigating through experiences with effective decision making to solve problems, and managing emotions during conflicts (Pianta, 1999).

Students who have deficits in social skills benefit from a curriculum that includes social awareness, social cues, regulation, and managing overwhelming feelings without losing control (Merrell, Streeter, Boelter, Caldarella, & Gentry, 2001). Nahgahgwon, Umbreit, Liaupsin, and Turton (2010) discovered that elementary programs with social skills learning concepts integrated into the curriculum decrease conflicts while increasing achievement. In this study, the observation of the classroom and interviews with teachers and clinicians helped to understand the supportive intervention in place during the use of IXL Math.

Educator's Perception of Technology

The twenty first century classroom utilizes technology that has altered how educators view curriculum and learning, moving to digital learning as necessary in the classroom curriculum (Voogt, Erstad, Dede, & Mishra, 2013). Craig (2000) found that the rapid deployment of mobile devices in the classroom created issues for teachers developing curriculum and lessons, and the rapid deployment is likely to impact the perception of teachers about technology. Furthermore, the signs of academic improvement after mobile device applications are used in the classroom, teacher perceptions may not reflect positive findings due to low confidence and the increased need for technological development (O'Malley et al., 2013). Therefore, teacher preparation and professional development should be a primary consideration for the success of mobile devices and applications in the classroom (Longnecker, 2014). Supporting 2e students through daily classroom experiences takes know-how, patience, and an understanding of students and academic content; however, the use of technology and mobile applications provide support for the academic achievement of 2e students (Moody, 2015). Cumming and Draper-Rodriguez (2013) reported positive feedback from teachers and parents regarding education performance after the implementation of mobile devices in the classroom when preparation and professional development occurred before deployment of technology and applications.

To implement supportive strategies, the compounded nature of working with 2e students takes understanding of their complexities. Developing a well-rounded understanding of 2e students takes collaboration with other educators,

specialists, psychologists, and special education teachers. This collaboration is recommended to support classroom teachers when accommodating strengths and weaknesses, social and emotional delays, classroom behavior, and differentiation (National Education Association, 2006). In this study, the collaboration of educators and clinicians was explored through interviews with the educators and clinicians that work with the 2e students.

Summary

Continued research is essential to meeting the needs of the underserved, 2e population. Teachers can benefit from professional development on methods, techniques, and strategies to adequately serve 2e students. Research has revealed that educators need to understand the complexities of 2e students related to their gifts and disabilities to support them in the classroom. Research has suggested that mobile devices can be supportive tools for 2e students, but questions persist for supporting achievement and self-efficacy of 2e students. A link is needed between the understanding that clinicians have regarding the self-efficacy of 2e students and the practical approaches teachers use in the classroom to meet achievement goals. This study explored the achievement and self-efficacy of 2e students when using a mobile device application and the perceptions of teachers and clinicians supporting them.

Chapter III
Research Methodology

This chapter provides a detailed description of the single case study research design of one classroom, participants, instrumentation, and procedures used to conduct the study. Furthermore, a description of the participants, the role of researcher, the instruments, the method of administration of the instruments, and implementation of the study are discussed. An analysis plan for the qualitative data with data analysis protocols, limitations to data, and protection of participants is described. This chapter concludes with a summary of all the pertinent details and the purpose and research question restated as a guide for the focus of the study.

Research Design

The researcher collected qualitative and quantitative data to explore the research question. Qualitative research design with interviews and observations allowed for the data collection from participants in their natural classroom setting (Creswell, 2003). The quantitative data collected included pre- and post-administration of the Patterns of Adaptive Learning Scales (PALS) and the Adaptive Diagnostic Assessment of Mathematics (ADAM), interviews with open-ended questions, school progress reports, IXL Math reports, and observations. The use of observations to build a foundation of code and theory was essential in the exploratory nature of qualitative research (Leedy & Ormrod, 2005). Thick description from the interviews and observations was used in the coding process to allow for the interpretation of theories explored by the researcher.

The research design used is a case study research design, defined by Yin (2003) as a study that develops out of a real-world framework to explore a phenomenon in the natural environment, describes the “how” or “why” questions posed, and occurs such that the investigator has little control over the environment. Therefore, the exploration of achievement and self-efficacy of 2e students when using IXL Math was best suited by using a case study research design. The multiple variables considered in case study research outnumber data points, depend on triangulation, and aid as a guide to framing the data analysis (Stake, 1995; Yin, 2003). The case study design has five elements: (1) the research question, (2) the codes or theories established by the researcher, (3) the case study, (4) the data, and (5) measures used for interpreting the results (Yin, 2003).

Setting and sample. The study setting was a small, private, award-winning school. The school was the recipient of the Innovation Award in Gifted Education awarded in 2016 by the Texas Association of Gifted and Talented for the school’s unique approach to meeting the needs of gifted students. The school serves twice-exceptional (2e fifth- through eighth-) K-8th grade students. The classrooms in this study consist of an elementary class with three students at the third-grade math level, and two students at the seventh-grade math level. One seventh-grade student not included in the study did not sign the assent form.

Students. This study was a purposeful sampling (Patton, 2002) of gifted students with a secondary diagnosis of autism, speech and language impairment, or emotional disturbance (ED). For the purpose of this study, the participants were

identified as 2e students by using standardized test results, psychological tests, and the observations of the professionals involved in their education (Table 1). The participants did not undergo additional psychological or intelligence testing to be identified as 2e because the students had prior testing before being enrolled in the school. Students not enrolled at the beginning of the study or who did not give consent for inclusion in the study did not participate. The WISC-IV full-scale score of all participants ranged from 132 to140, all classified as superior (Table 2).

Table 1
Student Profiles

Student	WISC IV Full-Scale Score	Diagnosis	Age	Math Content Level	Gender	ADAM Pre-Test
William	135	Speech and Language Impairment	7	2	M	3
Lucas	138	Autism	9	4	M	3
Kyle	132	Autism	8	3	M	2
Chris	135	Autism	13	7	M	4
Grace	140	Emotional Disturbance	12	7	F	3

Table 2
Wechsler IQ Classification (WISC IV)

IQ Reference Chart	
Low Average	80–89
Average Intelligence	90–109
High Average	110–119
Superior	120–129
Very Superior	130 and above

Note: from *Wechsler Intelligence Scale for Children,* Fourth Edition (WISC-IV)

Classroom teachers. The two classroom teachers participating in the study worked directly with the student participants. The teachers both hold graduate degrees in education. One of the teachers has three years of teaching experience, and the other has 11 years of educational experience. The teachers

provided mathematics instruction guided by the Texas Essential Knowledge and Skills (TEKS) while individualizing mathematics instruction to meet the needs of each student academically, socially, and emotionally. The teachers' classroom approach created an environment conducive to cross-age integration, allowing for collaboration, communication, and creativity across multiple age groups. Teachers in both classrooms taught the core academic subjects: reading, language arts, math, science, and social studies.

Clinicians. The two licensed clinicians (Table 3), one is a licensed professional clinician and the other is a licensed clinical social worker certificate, supported the families of students enrolled in the school. One clinician had seven and the other had 19 years of experience working as child-development specialists in schools. At the research site, they met bi-weekly to support families with their home experiences with their children and to understand the complexity of their child's abilities and disabilities. The licensed clinicians observed students in the classroom weekly to develop an understanding of the experience each child was having in the classroom setting. The licensed clinicians met weekly with teachers to support the teachers understand how to meet the social and emotional needs of each child.

Table 3
Interview Participants

Participant	Role	Years in Profession	Gender
Libby	Teacher	3	F
Samantha	Teacher	11	F
Carol	Licensed clinician	7	F
Alice	Licensed clinician	19	F

Role of Researcher

I am co-founder of the special education school selected to participate in this study. In the 2015–2016 school year, my role was to support the establishment of the organization in its founding year. In the 2016–2017 school year, my role was the director of fundraising and grant writing. My responsibilities were organizing events, grant writing, and other fundraising tasks to minimize undue influence.

My main responsibilities were to ensure validity, reliability, trustworthiness, and ethical standards. Internal validity is the precision of the data collection and results to the existence of findings. Merriam (2009) recommended six approaches when developing internal validity: triangulation, member checks, adequate engagement, peer review, participatory or collaborative research, and examination of researcher's biases. My research study included triangulation, member checks, adequate engagement, peer review, and exploration of researcher's biases.

In case study research, the process of validating and ensuring a thorough and valid analysis and interpretation of data is the responsibility of the researcher (Merriam, 2009). Adequate engagement for this study included the use of multiple interviews, observations, and adequate consideration of documents to clarify and broaden my perspective of emerging themes. The reliability of this study ensures that the study can be replicated and strengthens the validity of the study. Merriam (2009) suggested that reliability relies on (1) the consistency and dependability of data collection, (2) triangulation of data collection, and (3) an

audit trail with a description of data collection and a thorough reflection of the problems encountered. This study includes an explanation for the study with a thorough description of the participants, data collection, and analysis. Furthermore, the triangulation of the data collection and analysis is explained. Interview protocols and observation forms were used to improve the reliability of this study.

A threat to the internal validity of the study could be that the participants answered interview questions trying to guess what was the researcher's preferred response. I addressed the potential threat to internal validity by reminding participants that they would not be judged based on their answers and that they must be completely truthful. Also, the participants were reminded that their positions, salaries, or standing at the school would not be affected by their answers.

Furthermore, the researcher's influence on the observations was considered. According to Merriam (2009), the effects of the observer are uncertain and difficult to pinpoint but do exist. The participants in the study knew my role was as an observer. However, I was not a participant in the process; therefore, the degree of my influence was minimalized (Hatch, 2002).

Measures for Protecting Participants

The study began after approval from the University of Houston and the private school granted approval. The University of Houston Institutional Review Board granted permission for the execution of the study with the research site (see Appendix A). Permission from the private school co-founder and board member

was requested and obtained to conduct research at the private school (see Appendix B). The identities of all participants were held confidential in coding interviews and data without linking to specific teachers, clinicians, or students.

The assent, consent, and permission forms process are described in the *Permission Forms* section. The coding process assigned code numbers to each participant. All information and responses remained in the researcher's possession. Participants were made aware that involvement was voluntary and that they could remove themselves from the study at any time.

Instruments

The two teachers administered the assessments, tests, and IXL Math activities. They administered PALS (to assess self-efficacy) and ADAM (to assess achievement) before and after the IXL Math intervention. The collection of documents to support the interviews and observations conducted in the single case study included: (1) PALS, (2) ADAM, (3) IXL Math reports, and (4) student progress reports. The reports and assessments were reviewed to develop a comprehensive understanding of the impact of IXL Math in achievement and self-efficacy of 2e students.

The following question guided this study:

> How does the use of a mathematics mobile device application affect achievement and perceptions of self-efficacy of 2e students, and the perceptions of teachers and clinicians who support 2e students?

Table 4
Description of Instruments

Measure	Technique/Instrument	Participants	Administered
Self-efficacy	Patterns of Adaptive Learning Scales (PALS)	5 students	Before the intervention
Achievement	Adaptive Diagnostic Assessment of Mathematics (ADAM)	5 students	Before the intervention
Observations		5 students	During the intervention
Perceptions of self-efficacy	Interview	2 teachers, 2 clinicians	After the intervention
Perceptions of achievement	Interview	2 teachers, 2 clinicians	After the intervention
Self-efficacy	Patterns of Adaptive Learning Scales (PALS)	5 students	After the intervention
Grade level	Student school reports	5 students	After the intervention
IXL achievement	IXL Math usage reports	5 students	After the intervention

Patterns of Adaptive Learning Scales (PALS) and self-efficacy. In this study, self-efficacy refers to a student's belief that he or she can apply skills to achieve success in math problem solving and can persevere for the duration needed to achieve success in math problem solving. Bandura and Schunk (1981) reviewed methods for measuring self-efficacy and recommended, "How sure are you?" type questions to best gather information about self-efficacy. A subscale in the Patterns of Adaptive Learning Scales (PALS) was used to examine self-efficacy of students in this study. The adaptation of the PALS includes a student scale with a five-point scale. The scale consists of the following responses: 1 = *Not at all true*, 3 = *Somewhat true*, and 5 = *Very true*. The subscale used for the

survey (Appendix A) was administered by classroom teachers. Students were told that they were taking a survey, not a test. The students were told that there were no correct or incorrect answers on the survey. They were also informed that the information from the survey would not be shared with the school administration, teachers, or family members. The students were told that questions sound repetitive to accurately measure the information gathered. Table 1 provides the subscale questions and reports the test manual's calculation of Cronbach's alpha for the subscale as .78, a good level of internal consistency reliability.

Table 5

PALS Subscale for Self-Efficacy

1. I'm certain I can master the skills taught in class this year.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

2. I'm certain I can figure out how to do the most difficult class work.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

3. I can do almost all the work in class if I don't give up.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

4. Even if the work is hard, I can learn it.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

5. I can do even the hardest work in this class if I try.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

Note: Alpha = .78

Adaptive Diagnostic Assessment of Mathematics (ADAM) and achievement. Adaptive Diagnostic Assessment of Mathematics (ADAM), a standardized test developed by Let's Go Learn, was administered to assess achievement. This comprehensive assessment aligns with the National Council of Teachers of Mathematics' five strands for building mathematical proficiency:

conceptual understanding, procedural understanding, strategic competence, adaptive reasoning, and productive disposition. The adaptive nature of the assessment maximized the data for each student while minimizing the testing time and anxiety. The assessment adapted to the students' responses getting easier or harder as they complete the assessment. The numerical scores from ADAM reports showed grade level equivalencies.

IXL Math. Qualitative and qualitative data were collected from standardized assessments, grading reports, and IXL usage reports. IXL usage reports include time used, standards mastered, and problems attempted. The data was used to describe the process of 2e students when using IXL Math. The use of IXL Learning activities and similar mobile applications was a part of normal classroom activity. The students were asked to use the mathematics mobile application on a daily basis for approximately 30 minutes a day for the duration of the study.

Interviews

The interviews were used to gather the perceptions of the teachers and clinicians regarding the use of IXL Math in the classroom. The interviews included semi-structured and open-ended questions on achievement and self-efficacy correlated to the use of IXL Math in the mathematics classroom. Merriam (2009) suggested preparing a protocol of questions for the interview. The interview questions (Appendix D and Appendix E) consisted of semi-structured and open-ended interview questions with some questions specific to each interviewee. Probing questions followed the prepared questions to ensure

adequate information was obtained from the respondents. Merriam (2009) contended that hypothetical questions, devil's advocate questions, ideal position questions, and interpretive questions were the categories of questions practical for interviews. Hypothetical questions afford the interviewee an opportunity to contemplate his or her thoughts and actions situation and are centered around, "What if?" The devil's advocate questions extracted the viewpoint of the interviewee by asking questions on delicate topics and centered on an opposing view of the circumstances. The ideal position question assessed the interviewee's stance on relevant themes in the case study and centered on the interviewee's view of an ideal circumstance. The final questions are interpretive, which give the interviewee a chance to delve into opinions, attitudes, and viewpoints to help the researcher appropriately clarify the interviewee's responses. The clear and precise nature of the questions ensures the interviewees understood the wording of each question. Along with interview transcripts to facilitate coding and analysis (Merriam, 2009), observations and field notes directly taken during observation were part of the primary source of data (Hatch, 2002).

I interviewed the teachers and clinicians after the observations. Teachers included were those working with the students taking part in the study. All teachers received a verbal explanation of the study. Upon verbal consent, a written consent form with a letter explaining the research study was hand delivered to each participant for signature.

Clinicians working with families of students taking part in the study were included in the interviews. All clinicians received oral explanations of the study.

Upon verbal consent, a written consent form and a letter explaining the research study was hand delivered to each participant for signature. The clinicians met twice a month with the families to provide support and met multiple times a week with teachers to promote social and emotional learning in the classroom. The clinicians supported teachers when students struggles were more intense than the teacher could manage in the classroom.

I interviewed the teachers and clinicians at the school in a private office space used by teachers and clinicians with no one else present. The interviews lasted approximately 45 minutes. I wrote notes during the interview. The interviewee was instructed that all answers were to be given voluntarily and that they the choice not to answer any question. An audio recording of each interview was kept confidential, and only I had access. The audio was transcribed and reviewed for accuracy, then destroyed to protect the participants' privacy.

Observations

Merriam (2009) suggested researchers use field notes and research reflection in data collection through observations. The observation data collection form (Appendix B) was used to accurately record the setting. The natural classroom setting, the actions and behaviors of students and teachers, discussions, other elements contributing to the environment, and my own behavior as a researcher were all factors Merriam (2009) considered to be part of the observational natural setting.

For the purpose of this study, observations were used to collect data about the five students in their natural classroom setting. The natural setting established the stage for information gathered during the observation. The participants

brought to life the characteristics and data I collected. The actions and behaviors supported my understanding of the attitudes and viewpoints of the participants. I documented the discussions in the classroom by taking notes and writing direct quotations. I documented other elements like nonverbal and physical cues to create a well-rounded measure of my perspectives. My field notes, descriptions, and details I remembered immediately after leaving the observation site were added to the field notes. The nonverbal cues, such as physical boundaries and expectations, were written down in brackets and used to create protocols.

I conducted the observations during the student's use of IXL Math. The teacher participants were briefed on the study purpose before they signed the participation consent form. After setting appropriate observation times, the observations took place using the observation data collection form with relevant criteria, such as observing verbal cues, nonverbal cues, behavior, and engagement. The four scheduled observations lasted approximately 45 minutes each.

Data Collection Plan

Yin (2003) recommends the use of multiple sources outlined in the data collection plan to support the construct validity of the case study. The sources used in the data collection plan were documentation, archival records, interviews, and direct observations, which are resources Carspecken (1995) emphasized the use of prior to the implementation of the data collection.

protocols for validity and reliability of the study; therefore, protocols were set

Permission Forms. Parents were given an oral explanation of the study

before receiving the permission form (Appendix E) for student participation in the study. Parents could take the permission forms home to review before signing. After parental permission was provided, the school's clinical coordinator met with the students to discuss the research project and review the assent forms. Students between the ages of 6 through 9 were read an oral assent script (Appendix F) by the clinical coordinator when they received the Assent to Participate in Research Ages 6-9 (Appendix G). The students ages 10 through 14 were given the Assent to Participate in Research Ages 10-14 (Appendix H) form and were asked to read the form. The clinical coordinator was on hand to answer any questions regarding the research. The students were made aware that their participation was voluntary, they would not be penalized for not participating in the study, and they could discontinue participation at any time. They also given an opportunity to take the form home to go over it with parents before signing.

Data Analysis

Data analysis can coincide with data collection. Qualitative research is often met with an amount of data that can seem too enormous to process. The overwhelming nature of qualitative research can be minimized when the researcher begins to analyze the data early in the study (Merriam, 2009). The semi-structured interviews were transcribed to uncover themes during the coding process. The transcripts for each interview were read before I took notes in the margins. During the multiple readings of each transcript, I read the transcripts with notations in the margins to identify emerging central themes. This step led to distinguishing a coding system to best organize the themes. The small scale of the

study made it conducive for coding by hand. Each interview was coded individually to identify common themes (Creswell, 2003; Merriam, 2009). As the coding progressed, a meaningful collection of themes evolved that "goes beyond descriptive and theme identification and into complex theme connections," (Creswell, 2003, p. 189). This format of coding revealed the essential topics learned from the study (Lincoln & Guba, 1985).

Triangulation occurred by applying multiple sources of data and validating information in the findings (Creswell, 1998; Hatch, 2002). Triangulation was applied in this study by using multiple data collection methods of interviews, observations, and documents. The use of multiple sources provides depth and effectiveness that created significant findings (Hatch, 2002). Member checks consisted of asking for feedback from the participants after completion of interview coding themes. The process of member checking allowed the interview participants to read through researcher's interview coding themes to evaluate and confirm accuracy. During the process of member checking, I provided the interview participants a copy of the interview coding themes to ensure that the responses were accurately stated and interpreted. The process presented participants the chance to dispute the responses and clarify statements. Member checking assured that the participants' words, interpretations, and themes were authentic and genuine. The process of member checking did not reveal any necessary adjustments. The use of triangulation and member checking helped maintain validity and reliability of this study.

A colleague at the University of Houston reviewed the coding scheme. The peer reviewer examined the coding scheme for accuracy and validity (Guba & Lincoln, 1999). Biases were critically investigated in the data collection and analysis of the study. External validity of research in a natural setting, as is the case in this study, is contingent on applicability and generalizability (Guba & Lincoln, 1981). IXL Math follows the standards of Texas Essential Knowledge and Skills (TEKS), Common Core, and in other countries, which made content areas of the study generalizable to other schools in the United States and outside the country.

Summary

The pre-post design study included the use of the ADAM to describe achievement and PALS to describe efficacy when 2e students were using IXL Math. Usage reports were collected from IXL Math to explore IXL achievement, and school documents were used to identify student grade levels. Finally, observations and interviews were used to explore the perceptions of teachers and clinicians working with the 2e students.

Chapter IV

Results

The purpose of this study was to explore the achievement and efficacy of 2e students using a mathematics mobile device application and the perceptions of teachers and clinicians supporting them. Furthermore, this study identified barriers and solutions to address achievement and self-efficacy of 2e students using mathematics applications.

This chapter presents findings from four interviews, descriptive statistics from ADAM, descriptive statistics from IXL Math, and descriptive data from school progress reports. The following research question was used to examine this study: how does the use of a mathematics mobile device application affect achievement and perceptions of self-efficacy of 2e students, and the perceptions of teachers and clinicians who support 2e students? During the process of qualitative inquiry, topics about teaching 2e students, like motivation, arose beyond the initial investigative scope. This chapter describes the results of four interviews, four observations, pertinent document analysis, and qualitative data. A total of four participants were interviewed for the study: two teachers and two licensed clinicians.

Interviews

Interviews were conducted in person lasting approximately 45 minutes. The process of interviews provided the opportunity to understand the perspective of others (Patton, 2002). The interviews were conducted in a private office space on campus. The interviews were recorded and written notes were taken during the

interview. Interview protocols guided each of the interview sessions. The results of each interview produced similar themes.

Interviews with clinicians. Two licensed clinicians were interviewed, both of whom serve as family consultants at the school. Their roles includes bi-weekly meetings with parents, observations in the classroom, individual meetings with students, and clinical meetings with teachers to support their classroom work. Carol was a licensed clinical social worker for seven years and had spent five of those years working in school settings while maintaining a private practice. Alice was a licensed professional counselor for 19 years and spent 15 of those years working in school settings while maintaining a private practice.

Three topics emerged from the clinician interview responses: supportive methods for implementing mobile devices applications, parent support, perceptions of achievement, and teacher support. A peer reviewer analyzed the transcripts to confirm the prominence of these topics in the interviews. The peer reviewer was a colleague in the doctoral program at the University of Houston. Although as the reviewer I thought the themes were accurate, there were instances when the coding was inconsistent due to coding error. The reviewing process supported my attempts to further study the coded themes to correct inaccuracies.

Supportive methods for implementing mobile devices applications.

Carol said that using a mobile device application was helpful when the students had teacher support. Carol recognized that students had a tendency to become unaware of others and their sounds and actions when they used the device without adult support. Carol commented that students would get “lost in a cyber-

zone" when using the application by themselves. According to Carol, IXL Math was an enriching learning tool, but teachers sometimes fell into a trap when they realized that they can take a break and let the student stay in a zone. IXL Math can become an unplanned pacifier while the teacher takes a break. Carol believed that the use of mobile device applications, like IXL Math, needed to be planned and connected to academic learning outside of the application. Carol recommended that the application not be used as a way for the teacher to occupy students but as a way to gauge a child's understanding.

Carol often worked with students who wanted to bring devices to her office during meetings. Instead of barring devices from her meetings, she used the occasion as an opportunity to open a dialogue; the device can facilitate an open discussion with the child about current experiences. For example, she shared an experience about exploring a child's family worries when a child shared videos he watched on YouTube, all related to familial relationships. The point was not to disrupt the child's experience but to build a safe space for the child to share worries, feelings, and thoughts.

Parent support. The school's approach was to acknowledge the importance of the parents in the child's success in school and at home. By developing secure relationships with the parents, the clinicians established trust and common goals. A goal that both clinicians shared was to support the parents' understanding of their child's experiences.

Alice commented that the undue pressure on students from parents often stemmed from "parent anxiety, wishful thinking, and expectations" they had for

their child. There were instances when going deeper to understand the background and history of the parent was essential to understanding a current phenomenon in the parent-child relationship. Carol commented that helping parents understand their child's experiences occurred in two parts: "… think about what their experience was like when they were their child's age and what learning was like for them at that age," and "helping them with their narcissism."

Teacher Support. The expectations teachers set out for themselves trickled down to the expectations teachers had for their students. Alice helped teachers experience unsuccessful lessons as opportunities to help students succeed academically, socially, and emotionally. Carol believed that teachers should create a "neutral and safe space for kids to learn." Creating a safe environment was supportive for neutralizing emotions and helping students to focus on the learning.

Carol described three things that teachers should be aware of when supporting students: notice, be gentle, and ground them. She said teachers should notice when a student checks out. There are different signs that a teacher might notice that resemble an almost trance-like state. Carol described students that would stop in the middle of a task and go into a daze, while sometimes fidgeting. Even in instances when students were in the middle of a mobile device activity, she saw students come to a complete stop and be unaware of surroundings and the task at hand. This experience can cause a teacher to feel "angry or disrespected," but it is often "not in the child's control." Carol explained that being "gentle" in the approach to bring them back to the classroom experience is important,

because the student might need time to process his or her experience. Finally, the teacher should "ground" the student by helping the child to be in the present. She explained that "when a child is met with anger, that can drive them further away." The arduous task is for teachers to relinquish their expectations of student engagement and behavior to meet the student's needs.

Interviews with Teachers

Two teachers interviewed. At the time of the interviews, Libby had taught for three years and held a master's degree in education. Libby taught seventh-grade math. Samantha had taught for eleven years and has a master's degree in education. Samantha taught third-grade math. The themes that emerged from the teachers' responses were student responses to correct answers versus incorrect answers, IXL Math performance, and the importance of self-efficacy.

Student responses to correct answers versus incorrect answers. One of the themes that became apparent in the interviews with teachers was related to student responses to correct answers versus incorrect answers. Libby explained that "the biggest struggle" occurred when a student answered questions incorrectly on IXL Math. This was the moment when a prompt appeared at the top of the screen reading the words "sorry, incorrect" and a lengthy description followed explaining the process to answer the problem correctly . The students did not seem to read through the response. The students felt as though this response was just a slap in the face that they were not used to when they began using IXL Math. Preparing students for situations like getting a question incorrect was important when working with a student who struggled socially and

emotionally. One incorrect answer often led to the end of the IXL Math activity because it was too hard for students to handle if another incorrect answer prompt popped up on the screen. Many students internalized this type of response as if they were complete failures.

IXL Math provides immediate feedback to students with messages after every problem letting them know whether they were fantastic or answered incorrectly. Samantha explained that reminding students that they are practicing and the expectation is to be good enough was helpful. The expectation was not to get all questions correct; however, that fact took time for each student to believe and acknowledge. The harsh inner voice of a child often interfered with learning experiences and caused a child to believe that he or she was not capable of successfully completing classroom tasks.

The constant feedback of IXL Math contributed to many challenging experiences for students. Libby recommended the teachers prepare the students for using mobile applications that included helping students practice positive self-talk when students begin to feel frustration. This paid off when students were able to cope with incorrect responses instead of experiencing a meltdown. Libby commented that setting a time limit on tasks was helpful instead of setting a score goal for students who struggled with setting realistic goals during a lesson.

IXL Math performance. Although students experienced frustration, Samantha explains that “kids enjoy computer math and… it feels special and novel.” This was shared by Samantha regarding the reason students were excited about using IXL Math. Samantha explained that the impact was “10 times more”

when students answered correctly versus incorrectly. Words like “fantastic” flashed on the screen to acknowledge correct answers, along with an increase in the SmartScore, and possibly a medal depending on level of mastery. Samantha assumed that the excitement was related to the awareness of the IXL Math’s SmartScore, which was derived from an algorithm based on mastery. The IXL math SmartScore algorithm accounts for the number of problems completed, number of problems correctly and incorrectly, and problem difficulty. Furthermore, the algorithm rewards higher points for correct answers in a row. Samantha found it “amazing to watch the goal setting related to the SmartScore and award ribbons.” There was a sense of accomplishment and excitement when students received their third and final ribbon, according to Samantha. Supporting students to set realistic goals requires daily work because they desperately wanted to get to a 100 SmartScore, according to Samantha. It was not a realistic goal when students were struggling who still hoped to reach their personal goal of 100 SmartScore. However, Samantha recognized the sense of pride when they felt they reached a goal. Samantha believed that the part of IXL Math that was a motivating factor was getting “prizes for answering questions, time spent, and skills mastered.” Samantha went on to state that there was “not an external value” for the game board prizes because the prizes were images of objects.

Teachers experienced a difference in the effort they exerted helping students recover from disappointing situations when using IXL Math versus recovering from disappointment when using the textbook or manipulatives. Samantha stated that it was easier to get students back to using IXL Math after a

frustrating situation because they wanted to use it and enjoyed the application. Samantha explained, “I rank IXL Math at the top for supporting achievement.” Even though students experienced feelings of intense frustration when use IXL Math, Samantha believed that students had a sense of pride when they mastered a skill due to the reward system.

Importance of supporting self-efficacy during IXL Math. Samantha believed that social and emotional skills should be a part of learning for every child, not just twice exceptional students. There were no state standards that supported teachers to think through the social and emotional needs of each child; however, Libby and Samantha recognized the importance of including social and emotional learning during curriculum development. Dealing with the inconsistencies of 2e students was frustrating for both teachers, but Samantha pointed out that she was not motivated by controlling her students. She conveyed that her job was to help her students develop coping skills to control their own feelings and emotions. When students struggled using IXL Math, the root of the problem was not always initially evident. Often, Libby found that the decrease of the SmartScore triggered frustration and anger. At times, the teachers identified that the mere mention of IXL Math caused students to be overwhelmed and frustrated because the students felt as if their good work and correct answers were wiped away when their SmartScore decreased. The teachers believed that students felt shame when the notification prompt of incorrect answers on IXL Math appeared on the screen. These experiences gave the teachers opportunities to help students identify that making mistakes was part of learning.

Cross-age integration. The students were separated by a half wall with the elementary students on one side and the middle school students on the other side. According to Samantha, this made it "simple for cross-age integration and mentoring." The students ranged in academic levels, but all students were working on similar social and emotional skills on throughout the day. For instance, Samantha stated that regulating emotion was a common area of struggle for all students. The students often supported one another when using IXL Math by being positive models for one another. Moments of frustration could lead a student to want to quit the application; but when other students were succeeding at their activity, it provided an incentive for others to continue to work on their IXL Math activity. Libby said that she thought that was the competitive nature of some students. The students wanted to be the first one to unlock certain objects on the prize board or get to the 100 SmartScore. The peer support was most helpful, according to Libby, when the middle school students helped the elementary students work out difficult problems. These types of interactions supported the students in feeling cared for and feeling like they were a part of the classroom experience, not just their own experience. This kind of "experience can support both students with confidence and social awareness," stated Samantha.

Observations

The purpose of the observations was to explore the natural setting of participants, their actions and behaviors, discussions, other elements contributing to the environment, and the researcher's behavior in the setting (Merriam, 2009). The four observations of the classroom setting supported the foundation of coding

and data analysis explored in this study. The two emerging themes were student responses to incorrect answers and student responses to correct answers,.

The four observations did not last more than 45 minutes for each observation. The data observation form was used to collect the following data in the classroom: verbal cues, non-verbal cues, behavior, and engagement. After consent forms were received, the observations were scheduled for one per week when the students used IXL Math. Observing the classroom environment provided an opportunity to make sense of the classroom setting. The observation process provided me to write descriptions of the interpretations that surfaced through the study (Hatch, 2002).

All four observations of both third grade and seventh grade math classes were structured the same way. The elementary teacher (Samantha) worked one-on-one with each student to prepare for an independent math activity. The lesson started with an individualized introduction to the math concept, individualized guided practice, independent practice, and ended with IXL Math. The seventh grade students began with a group lesson on the math concept. The middle school teacher (Libby) started with an introduction, guided practice as a group, independent practice, and ended with IXL Math.

Student responses to incorrect answers. During Observation 1, the frustration level of Lucas was marked by his negative self-talk, referring to himself as stupid. Samantha sat next to him until he answered several questions correctly while preparing him to do the work alone. Samantha prepared him by

reminding him that she was not helping him to do the work, he was not expected to get them all correct, and she would be near if he needed help. After seeing him solve the problem after that, the teacher supported him while he solved the next problem. She assumed he worried about seeing the word “incorrect” on the screen. After going back and forth with the student reminding him about the IXL Math activity being awas practice activity, he was able to persist and remember that there was a helpful part to seeing the word “incorrect” on the screen because a step-by-step solution would follow.

During my observations, the teachers seemed to be aware of social and emotional struggles that occurred in response to incorrect answers. For example, in Observation 3, the lesson was irrational numbers. After completing the group lesson, individualized instruction, and independent practice, the students worked on IXL Math. To support social skills learning, the teachers planned group instruction when lessons aligned with all content areas for all middle school or all elementary students. A group lesson was taught, followed by individualized lessons that supported the current mastery level for each student.

In one observations, Chris was working quietly until Grace interrupted. “I have been working on this, and all I have is 27 points,” yelled Grace. Grace further exclaimed, “I hate this.” As the student was screaming, she began entering numbers and pressing buttons over and over. As Grace closed the screen on her computer, she asked for a break. The teacher agreed and let her know what they would talk about the work when Grace was calm enough. She grabbed her sketchbook that was placed at the corner of her desk and started drawing. The

teacher asked if Grace were ready to have a conversation about the work. After Grace agreed to talk, Libby opened the computer to where the student left off. Libby used a handheld whiteboard to work through one of the problems, and Libby realized that the work was starting. Grace said, “I don’t want to do this.” Libby gave her a couple of options: an option to do the work at that time and an option to do the work at “stock market time.” This appeared to be a time that Grace looked forward to, and she immediately agreed to work.

During Observation 4, Chris seemed to be more involved in Grace’s experience than his own. The students each had a handheld whiteboard to work out problems in the group lesson. Each student had the same six problems to work through on their whiteboard. Chris and Grace finished the work without needing help and moved on to work on IXL Math. Grace confirmed with the teacher that the expectation was to work for 20 minutes and not get a certain score. Once she got confirmation, she began working. They both chose to use the dry erase board work out problems, instead of paper. Chris turned to Grace telling her “she is hogging the eraser,” which appeared to be a tactic to get her attention. The teacher pointed out that there were other erasers. He was insistent about using a particular eraser. Both Chris’ and Grace’s computer froze within five minutes of each other, which appeared to throw off their momentum. Grace began doodling on the dry erase board, and Chris tried to figure out what Grace was doodling. Once the IXL program was working, it took both students a few minutes to get back on task.

During the same Observation 2, Lucas appeared to be confused about whether to add or multiply during the assignment. Lucas was using mental math

to solve the problems but was getting them incorrect. When the teacher noticed, he was pressing a button and giggling. As Samantha got closer, he yelled, “Don’t take it away.” The teacher removed the computer and began supporting him to regulate his emotions. The teacher’s moving the computer appeared to frustrate him more, which prompted louder yelling. The teacher responded with, “Is yelling going to change what I decided to do?” He responded, “No!” He was asked several times about whether he wanted to continue working on IXL Math. Even during the yelling, the teacher did not leave his side. She remained calm, patient, and repeated to him that he was not in trouble. This seemed important, because he appeared to be under the impression that he had lost his opportunity to continue using IXL Math. After he was calm thatcalmed down she discussed her expectations for using IXL Math. He was eventually able to express that he was randomly clicking the buttons, because he liked to see the responses from the application pop up on the screen. The teacher worked with him on a plan to do IXL Math for five minutes before stopping the activity. After setting the timer, she returned the computer, and he started working. He appeared worried that the timer had not been set. He went over to look at it, then seemed comfortable enough to begin working.

Student responses to correct answers. In my observations, there appeared to be different responses to correct answers. In Observation 4, Samantha announced to the students that they were starting the math assignment. After completing independent assignments, Kyle moved on to working on IXL Math. Samantha prompted him to work for 20 minutes, but he expressed that he wanted

to earn a 100 SmartScore. She agreed to the goal of 100 SmartScore but reminded him that it was practice and she did not expect him to get a 100 SmartScore. As Kyle worked on IXL Math, I noticed him wiggling in his seat with excitement. He appeared to be cheering himself along the work. In a monotone voice, he said that he "won a medal" getting the teacher's attention. The medal seemed to be an important accomplishment for him. It was seemed that his work was to get the medal, not to learn. Samantha reminded him to be aware of others working and congratulated him on his work. Samantha sat down next to him to see his progress and realized that he has answered 94 questions. After asking about the 94 questions answered, Kyle responded, "I wasn't trying in the beginning." About five minutes later, Kyle completed his goal of 100 SmartScore. When Samantha asked about his feelings regarding the work he accomplished, he responded, "I achieved my goal, and I feel proud." I noticed that the goal was a 100 SmartScore.

William was working next to Kyle during this observation time. William was oppositional about getting started with IXL Math. He appeared to believe he was incapable of doing the work on his own and repeated several times that he did not want to work on his own. The teacher reminded him that she would get him started by working the first couple of problems with him and that she did not expect him to get all of the answers correct. Although she sat next to him, he appeared to be incapable of doing the work without her help. She asked him several times, "Am I doing the work for you?" He had the biggest grin on his face each time and responded, "I did it." As he progressed, he lifted his bottom off the chair with excitement. Then, he got one wrong, and the teachers looked at him

wondering what his response would be. Mumbling to himself, he appeared to be reminding himself of the teacher's words about not getting all of the answers correct. Samantha stopped him before he moved on to the next problem to share her proud feelings that he did not get out of control with frustration when he missed the problem. This showed the importance of acknowledging the successful social and emotional coping skills, not just the academic progress. He continued until he reached the 100 SmartScore. He went from being adamant about not doing the work to asking for more work. He wanted to practice another skill, which I noticed happened several times during my observations. It appeared that the students wanted to hold onto the feelings of accomplishment. Realizing that his IXL Math practice was over, he quickly asked to check the reward board. He earned a backpack for mastering the skill and was so thrilled that he turned to computer screen around to show off his prize to his classmates.

The middle school students appeared to be less preoccupied with the prizes and more concerned with the SmartScore point system. For example, Grace got frustrated about the amount of time she spent to earn only 27 points. When the SmartScore decreased, I observed students immediately want to quit and appeared to lose motivation to persist through the activity. According to IXL Learning, Inc. (2016), the SmartScore is based on IXL's proprietary algorithm that measures a student's understanding of a math concept. The range is 0–100 and is based on several factors, including several questions completed, difficulty, and consistency. The IXL Math program considers 80 as good, 90 as excellent, and 100 as mastery.

I observed Grace when she went from struggling to progressing through the topic. She appeared to perk up when Libby recognized her lowered frustration level lowered and the progression of her work. Conversely, Chris did not appear to be receptive of the praise until he reached his goal at the end of the assignment. There seemed to be a combination of relief to be at the end of the work and a sense of pride.

Quantitative Data Analysis

Data from the PALS, ADAM, and IXL Math was examined to show descriptive statistics for each student on achievement and self-efficacy. Student profiles consisted of data from school files, ADAM assessment, IXL Math reports, and PALS. The PALS pre-post test results were used to describe efficacy. I used the pre-test and post-test results from ADAM to describe achievement. The ADAM assessment tested the students' knowledge of skills at their grade level. Although the students were tested for all skills, the study was especially relevant for the first content area, Numbers and Sense for the elementary students or Numbers and Operations for the middle school students including seven major testing areas. The three elementary students were on different grade levels, and they were working on different sub-construct areas of Number and Sense and Number and Operations. The two middle school students were in the same grade level, but working on different sub-constructs in Numbers and Sense and Numbers and Operations. The descriptive statistics from IXL Math included time spent, questions answered and skills mastered for each student. The IXL Math

questions answered were primarily related to the content area of Numbers and Sense and Numbers and Operations.

Student Profiles

Student 1, William. William, age 7, was a boy in the in the second grade. His Wechsler Intelligence Scale IV (WISC-IV), full-scale score, was 135. William was diagnosed with autism in pre-school. In first grade, he was also diagnosed with attention-deficit/hyperactive disorder and anxiety. His records showed that he had been attending a private school until he was asked to leave due to challenging behavior in the classroom. At the time of the study, he was working above grade level in all of his subject areas. William appeared to be a high-spirited, happy boy. During my observations, he required constant encouragement and redirection to complete his tasks. He seemed to respond well to positive reinforcement. During observation 1, I noticed that he was in opposition about doing his math activity. when saying "I don't want to … ." The teacher reminded him that she would not leave him until she was certain he could do the work without her support.

He seemed to gained confidence after completing the task on his own. William's ADAM results (Table 6) show an increase in Numbers and Sense from 26 to 34, Measurement from 9 to 18. Data analysis stayed the same at 8. Geometry decreased from 15 to 14, which was not a significant drop. His total raw score was 78 for the post-test with a maximum raw score of 59 for his grade level. He spent approximately .8 seconds on each IXL problem (Table 7). This was also representative of observations that once he gained confidence in his

ability, he persisted through the task with focus and determination. His PALS efficacy (Table 8) increased from 2.8 to 3.6. Although he started off oppositional about the work, in my observations, he asked for more work after being done with his task.

Table 6
ADAM: Student William

Summary Scores (Score ranges by grade)									
K	1	2	3	4	5	6	7	Pre Raw Score	Post Raw Score
Numbers and Operations									
1-4	5-13	14-22	23-41	42-61	62-83	84-91	92-105	26	34
Measurement									
1-2	3-4	5-12	13-18	19-26	27-31	NA	32-34	9	18
Data Analysis									
1-1	2-4	5-9	10-12	13-16	17-21	22-27	28-36	8	8
Geometry									
1-4	5-7	8-10	11-19	20-30	31-36	37-44	45-53	15	14
Algebra									
1-1	2-4	5-6	7-13	14-20	21-25	26-31	32-43	7	11
TOTAL									
0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	65	78

Table 7
IXL DATA: Student William

IXL Data	Time Spent (Minutes)	Problems Answered	Problems Incorrect	Skills Attempted	Skills Mastered
Student William	404	517	22	23	20

Table 8
PALS: Student William

PALS		
	Pre	Post
Student William	2.8	3.6

Student 2, Lucas. Lucas, age 9, was a boy in the fourth grade. His WISC-IV, full scale score, was 138. He was diagnosed with autism and expressive

language/fine motor/gross motor delays in third grade. At the time of the study, he was working at grade level in all subjects. Before being enrolled in this school, he had attended three other private schools. His parents removed him from the three previous schools, because the "schools did not meet his needs." He appeared to be a bright, creative, and boisterous boy. He seemed to be deliberate about his actions. During Observation 1, I observed him erasing an answer. As he erased and erased, his teacher noticed and discussed with him the expectations of good enough. She asked several times whether he needed to be good enough or perfect. After the third time, he was able to say that he just needed to be good enough. He appeared determined to rip through his paper by erasing obsessively.

His raw score decreased in three of the five constructs of the ADAM (see Table 9); however, his overall score increased from 74 to 78. During IXL Math (see Table 10), he mastered 12 skills. His IXL Math time spent answering problems is the lowest of the group spending a total of 165 minutes out of a possible 450 minutes using IXL Math. Regulating his frustration appeared to limit his time spent on IXL Math. His PALS efficacy (see Table 11) increased from 3.4 to 4.2. He appeared to struggle in regulating his frustration during the academic activities, but began and ended with positive attitudes about his math ability.

Table 9
ADAM: Student Lucas

Summary Scores (Score ranges by grade)									
K	1	2	3	4	5	6	7	Pre Raw Scores	Post Raw Scores
Numbers and Operations									
1-4	5-13	14-22	23-41	42-61	62-83	84-91	92-105	40	41
Measurement									
1-2	3-4	5-12	13-18	19-26	27-31	NA	32-34	4	14
Data Analysis									
1-1	2-4	5-9	10-12	13-16	17-21	22-27	28-36	6	5
Geometry									
1-4	5-7	8-10	11-19	20-30	31-36	37-44	45-53	12	11
Algebra									
1-1	2-4	5-6	7-13	14-20	21-25	26-31	32-43	12	7
TOTAL									
0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	74	78

Table 9
IXL DATA: Student Lucas

IXL Data: Student Lucas	Time Spent (minutes)	Problems Answered	Problems Incorrect	Skills Attempted	Skills Mastered
Student Lucas	165	401	84	20	12

Table 10
PALS: Student Lucas

PALS		
	Pre	Post
Student Lucas	3.4	4.2

Student 3, Kyle. Kyle, age 8, was a boy in the third grade. His WISC-IV, full-scale score, was 132. In second grade, he was diagnosed with autism, dyslexia, and anxiety. At the time of the study, he was working at grade level in all subjects. Before his current school, he attended public school where he was working below grade level. He appeared to be a quiet boy with flat affect. He was monotone and expressionless when he accomplished his IXL Math task.

During observations, Kyle began his math work with a comment about already knowing how to do the content. He approached the work with overconfidence that appeared to be a detriment to his self-efficacy when he realized he needed to redo the work or needed the teacher's support. Watching his peers learn and internalizing those vicarious experiences, his frustration did not help with his efficacy. He increased in every construct in the ADAM (Table 12), including his overall score from 45 to 70. The maximum raw score for his grade level is 103. His PALS efficacy (Table 14) decreased from 4 to 3.4. The most significant decrease in the PALS pre-post was the decrease of 4 to 2 response to the first prompt: "I'm certain I can master the skills taught in class this year." This shows his ambivalence observed in the classroom of overconfidence at the beginning of an activity, which led to low self-efficacy when he measured himself to others in this class.

Table 11
ADAM: Student Kyle

Summary Scores (Score ranges by grade)									
K	1	2	3	4	5	6	7	Pre Raw Score	Post Raw Score
Numbers and Operations									
1-4	5-13	14-22	23-41	42-61	62-83	84-91	92-105	17	29
Measurement									
1-2	3-4	5-12	13-18	19-26	27-31	NA	32-34	10	11
Data Analysis									
1-1	2-4	5-9	10-12	13-16	17-21	22-27	28-36	5	8
Geometry									
1-4	5-7	8-10	11-19	20-30	31-36	37-44	45-53	9	9
Algebra									
1-1	2-4	5-6	7-13	14-20	21-25	26-31	32-43	4	13
TOTAL									
0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	45	70

Table 12
IXL Data: Student Kyle

IXL Data	Time Spent (Minutes)	Problems Answered	Problems Incorrect	Skills Attempted	Skills Mastered
Student Kyle	306	801	203	25	15

Table 13
PALS: Student Kyle

PALS		
Prompts	Pre	Post
Student Kyle	4	3.4

Student 4, Chris. Chris, age 13, was a boy in the eighth grade. His WISC-IV full scale was 135. He was diagnosed with autism in the fifth grade. At the time of the study, he was working at the seventh-grade level in math and on grade level in all other subjects. Before this current school, he was homeschooled. He appeared to be an upbeat boy consistently seeking the attention of others. During observations, he sat in his chair at an angle where he could see his classmates and teacher. During classroom observations, he appeared to have high self-esteem in

his work and ability. He seemed eager to attempt the math work during each observation.

Chris's ADAM scores (see Table 15) did increase in all construct areas with an increase from 142 to 169. The maximum raw score for his grade level is 271 for his math grade level. After the three weeks of IXL Math (see Table 16), his PALS efficacy (see Table 16) increased from 3 to 4.2. His eagerness and high self-esteem was evident in the number of problems attempted in IXL Math (see Table 17). He completed 1,037 problems and mastered 27 skills, which was the most skills mastered compared to the other students. The adaptive feature provided students similar problems until the student showed mastery; therefore, the student had countless attempts to demonstrate mastery.

Table 14
ADAM: Student Chris

Summary Scores (Score ranges by grade)									
K	1	2	3	4	5	6	7	Pre-Raw Score	Post-Raw Scores
Numbers and Operations									
1-4	5-13	14-22	23-41	42-61	62-83	84-91	92-105	57	68
Measurement									
1-2	3-4	5-12	13-18	19-26	27-31	NA	32-34	23	27
Data Analysis									
1-1	2-4	5-9	10-12	13-16	17-21	22-27	28-36	18	20
Geometry									
1-4	5-7	8-10	11-19	20-30	31-36	37-44	45-53	19	24
Algebra									
1-1	2-4	5-6	7-13	14-20	21-25	26-31	32-43	25	30
TOTAL									
0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	142	169

Table 15
IXL Data: Student Chris

IXL Data	Time Spent (Minutes)	Problems Answered	Problems Incorrect	Skills Attempted	Skills Mastered
Chris	371	1,037	273	27	19

Table 16
PALS: Student Chris

PALS		
	Pre	Post
Student Chris	3	4.2

Student 5, Grace. Grace, age 12, was a girl in the seventh grade. Her WISC-IV, full scale score, was 140. She was diagnosed with emotional disturbance in fourth grade. At the time of the study, she was at grade level in math and above grade level in all other subjects. She appeared to be a mild mannered, sensitive, and creative girl. During observations, she had a sketchbook on her desk and frequently used it to draw. She seemed sensitive about her abilities and compared herself to others, especially when she struggled. The

comparison appeared to cause frustration and lower her self-efficacy. During observations, she required a lot of teacher support to get through the frustrating experiences and realized she was capable of mastering the work. Even with those overwhelming experiences with IXL Math (see Table 19), she mastered 23 skills. Her ADAM score (see Table 18) increased in three out of four constructs raising her total score from 99 to 123. The maximum score for her grade level is 271. Her PALS efficacy (see Table 20) went from 3.2 to 4 showing that the teacher's support paired with her ability to complete the work did help her self-efficacy.

Table 17
ADAM: Student Grace

Summary Scores (Score ranges by grade)									
K	1	2	3	4	5	6	7	Pre-Raw Score	Post-Raw Scores
Numbers and Operations									
1-4	5-13	14-22	23-41	42-61	62-83	84-91	92-105	45	53
Measurement									
1-2	3-4	5-12	13-18	19-26	27-31	NA	32-34	13	21
Data Analysis									
1-1	2-4	5-9	10-12	13-16	17-21	22-27	28-36	17	14
Geometry									
1-4	5-7	8-10	11-19	20-30	31-36	37-44	45-53	16	24
Algebra									
1-1	2-4	5-6	7-13	14-20	21-25	26-31	32-43	8	11
TOTAL									
0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	99	123

Table 18
IXL DATA: Student Grace

IXL Data	Time Spent (Minutes)	Problems Answered	Problems Incorrect	Skills Attempted	Skills Mastered
Grace	307	724	195	27	23

Table 19
PALS: Student Grace

PALS		
	Pre	Post
Student Grace	3.2	4

Chapter V

Discussion

The study addressed the following research question:

How does the use of a mathematics mobile device application affect achievement and perceptions of self-efficacy of 2e students, and the perceptions of teachers and clinicians supporting 2e students? I explored the study findings, as directed by the research question by using qualitative data from observations and interviews of teachers and clinicians working with 2e students and quantitative data from PALS, ADAM, and IXL Math usage reports of 2e students.

Training to Support Efficacy

The classroom environment was a factor in this study. The low teacher to student ratios was an important factor in supporting the efficacy of 2e students, because it provided teachers with the opportunity to focus on the needs of all students. The teachers reinforced coping mechanisms to support the students to regulate and maintain their emotions. Also, the teachers were trained by licensed clinicians who understood the students' family situations, home struggles, and had a well-developed framework of social and emotional struggles of 2e students. The licensed clinicians met with teachers regularly to develop strategies and create plans to support the varied needs of the 2e students.

The school in this study is unique because of the on-going support of the licensed clinicians for teachers and families. When school budgets occur, the extracurricular programing and clinical roles are typically the first to go. My experience is that there are many private school operating without a clinician to

support students, teachers, or families. Supporting the 2e students means that teachers need training to understand the social and emotional struggles each student. When teachers do not have access to licensed clinicians in the school, they can reach out to other professions for support and training.

Intrinsic Versus Extrinsic Motivation

The intrinsic motivation of students seemed to decrease during the use of IXL Math. The interviews with teachers and observations of the classroom revealed that the motivation of students was intertwined with the SmartScore, and the reward boards (images of teepees and backpacks). Zimmerman (2000) defined intrinsic motivation as an internal energy that self-initiates behavior and is based on natural needs. Intrinsic motivation is marked by creativity, flexibility, enjoyment, and judgments of competence (Deci, 1971). Extrinsic motivation results in behavior that is no longer carried out because it is interesting, but due to an external reward. The students in the current study appeared to be driven by the SmartScore, rewards, and receiving images of objects like teepees and backpacks.

The distraction of the Smartscore, rewards board, and medals presented a challenge for the 2e students in this study. While the intrinsic motivation of the students in this study suffered, it was the role of the teacher to support the students through their experiences. The teachers in this study supported the students deal with successes and failures while using IXL Math. The teachers praised the students when they made achievements while supporting them to cope with the feelings of achievement. The students did not always know how to regulate feelings of excitement when they accomplished a task, so it was the

teacher that supported them with understanding their success while helping them to acknowledge that they distracted their classmates with outbursts of excitement. On the other hand, the teachers supported the students during moments of failure. The 2e students struggled to regulate their feelings of frustration and disappointment when they perceived themselves as being failures. The teachers supported the students by acknowledging their effort, their successes, and supporting them to persist through the difficult feeling to complete the work. This often meant that the students needed to take a break before being ready to get back to the work. Although the intrinsic and extrinsic motivation of 2e students using IXL Math emerged as a topic in this study, I do not expect IXL Math or any other application to replace the role of the teacher to support 2e students learn social and emotional skills.

Unique Factors Lost in Education Technology Tools

A variety of factors can be considered when addressing the needs of students using mobile device applications, such as culture, family history, previous education experiences, learning strengths and weaknesses, and social and emotional development. A common experience of teachers using education technology tools is the lack of comprehensive feedback to serve their students (Molnar, 2016). IXL Math has updated their user interface with real-time analytical information for teachers, which provides information about when students are practicing, when students are idle, when students may need help, and the number of questions answered. If the teacher spends time behind a monitor looking at real-time analytics, he or she reduces the time spent with students. This

type of information appears beneficial to the purchaser who does not do the classroom instruction. However, this situation does not help the struggling student working to master content when the teacher is behind a monitor instead of supporting the struggling student (Molnar, 2016).

When the teacher spends time behind a monitor sifting through real time analytics, it deters the teacher from real time spent with students. As revealed in this study, 2e students are best served when the teacher is available to support them during the use of IXL Math. When the teacher works individually with the child instead of working on a computer, then the teacher will be able to support the child in real-time. The real-time analytics takes the teacher away from being available to support each child.

The valuable information that IXL Math suggest will create more efficient teachers is nothing but a distraction. The real-time features are just as distracting to teachers as the scoring features are to the students. The most efficient teachers will not rely on an application to uncover the struggles a student is experiencing during the use of IXL Math or any other application. The most efficient teachers will be engaged with their students to figure out the reason for the struggle. Reading the analytics report that shows a student is struggling is not helpful when the teacher is in the dark about the experience of the child. The teacher behind the computer monitor will not notice the student who decides to be silly and just start clicking buttons to see what happens. The teacher behind the computer monitor will not be there to support the student who masters an activity and is

unable to manage feelings of excitement. The teacher behind the computer monitor will not be available to support the child's social and emotional needs.

Implications

The purpose of this study was to investigate perceptions of achievement and self-efficacy of twice exceptional students using IXL Math and the perceptions of teachers and clinicians supporting them. The study provided a framework for future researchers to investigate the use of other mobile device applications with twice exceptional students. I recommend that any future study should include training for the implementation of the mobile device application and supporting social and emotional struggles of twice-exceptional students. Pajares (1996) suggested that teachers can extend supportive methods of developing self-efficacy by authentic praising, recognizing persistence and not just proficiency; encouraging positive attitudes, questioning unrealistic ideas of confidence; and acknowledging the ability with purposeful affirmation statements.

In many settings, the list of recommendations can be overwhelming to teachers who are working to meet the needs of 20 to 30 students. However, the benefit of the small classroom setting of the current study worked for implementing an approach to support self-efficacy of students in the classroom. The results from this study showed an increase in the mean of all students in PALS from 3.28 to 3.8 (Table 21) and an increase in ADAM total score from 85 to 104 (Table 22), which is an increase in one grade level in the ADAM. The

small sample does not yield a statistical significance estimate, however, practical results have been yielded from this study.

Table 20
PALS: Mean Pre-Post

PALS		
	Pre	Post
Mean from all students	3.28	3.88

Table 21
ADAM: Mean Pre-Post

K	1	2	3	4	5	6	7	Pre Raw Score	Post Raw Scores
TOTAL 0-12	13-32	33-59	60-103	104-154	155-196	197-224	225-271	85	104

Technology Is Not a Quick-Fix Tool

A slight exaggeration of one's ability can be helpful in motivation and persistence (Bandura, 1986). However, a "gross miscalculation between efficacy and performance" can result in struggles due to inaccurate perception of ability (Bandura, 1986) and can limit the ability to accurately gauge the required effort in mathematics. A minimal focus has been on the goals of self-efficacy and the experiences that attribute to building healthy mental perceptions of oneself because mobile device application performance metrics are designed with mastery goals and grade progression in mind (Bill & Melinda Gates Foundation, 2015). The expectations of technology being a magic formula for bridging academic and social gaps needs to be put to rest until supporting social and emotional learning are also considered in performance metrics.

Twice-exceptional (2e) struggle with accurately gauging their ability. In this study, the elementary students often wanted to do more work on IXL Math when they were successful on the assigned IXL Math lesson. The students did not take into consideration whether or not the content was completely different or more advanced than they ready to complete. The 2e students struggles with identifying their ability. IXL Math does not kick students out when they have answered over a hundred questions and are still failing, and it does not prohibit a student from moving onto the next lesson if they chose to do so. In order to support 2e students, I recommend features that lock students into a lesson and stop students when they answer multiple questions in a row.

Limitations

It might be challenging for a most school to have low teacher-to-student ratios, and clinicians assigned to every family would be difficult for most schools to replicate, especially where funding shortage ends in cutting therapeutic services in schools. The individualization and reinforcement of social and emotional skills might be difficult to replicate in other school settings as well. As discussed in the *Role of Researcher* section, my role could have influenced participants' answers to interview questions based their perception of the researcher's preferred response.

IXL Math Not Renewed

The school in this study decided against continuing the use of IXL Math as a classroom tool. Several factors led to this choice. In this case and for many other teachers, the teachers wanted systems that accelerate learning to provide

them with the ability to meet the academic, social, and emotional needs of each student (Pane, Steiner, Baird & Hamilton, 2015). The IXL Learning (2016) website states, “Unlike traditional workbooks and exercises, IXL offers hours of intrigue for students without distracting them from grasping key concepts.” However, the 2e students in this study appeared to be distracted by the bells and whistles that IXL Math prides itself on to engage students. Also, the students in this study required constant teacher attention. In this study, teachers utilized a multidimensional classroom allowing for differentiation of learning and individualized grading without social comparison. IXL Math allowed for flexibility of individualizing lesson for a classroom with multiple grade levels or multiple levels of mastery. However, the challenge IXL Math created for these 2e students in this study was that they compared their SmartScore, medals, and prizes to the accomplishments of their classmates. The students appeared to be extrinsically motivated by medals and pictures of objects. This created another set of challenges for teachers who were helping the students to focus on learning instead of imputing numbers to get the next prize. I would suggest to IXL Learning to add options that would allow teachers to disable the SmartScore and the rewards board. Another factor is the cost of IXL Math compared to other programs the teachers are using that are free, like Khan Academy, or lower in cost, like DreamBox.

In the interviews with teachers, the topic of the ADAM came up without prompting. They articulated that the use of the ADAM was easier to integrate into the classroom because it did not prompt students with incorrect or correct

feedback. The computerized assessment had a boy on the side with a soccer ball who would kick a ball each time a question was answered correct. The teachers experienced fewer emotional struggles with the use of the assessment and were provided with instructional guides that aligned to the state standards. The experience of students using IXL Math versus ADAM revealed a difference in goals and value of learning focus. A key finding in the study of adaptive learning tools is that goal setting and the value of learning are driven by achieving a score rather than learning. The learning during IXL Math activities appeared to be driven by achieving a higher SmartScore and receiving medals. The students did not seem to lose the value of learning in the process of using ADAM. The school will continue to use ADAM due to the ease of utilizing it as a classroom tool to identify specific gaps in knowledge and minimal distractions it presents for students during testing time.

Teachers Renewed

The teachers in this study had the support of clinicians that helped them understand the experiences of 2e students in the classroom. The students had a tendency to struggle due to social and emotional delay, past failures, and home struggles. The collaboration of teachers with clinicians helped them to see that a student slamming a computer screen down was not just because of defiance or other behavior issue. The clinicians able to help teachers reframe a behavior into a social and emotional struggle. For instance, a student that refuses to complete a task after having an unsuccessful experience is not disrespectful but frustrated and afraid to risk failure. The teacher needs to be able to support the student through

that experience. Often, this means that the frustrating task is removed before the student can get back to the work.

The teachers in this study are renewed, because they understand that their 2e students will master the academic content once they have gained the social and emotional skills needed to cope with their experiences in the classroom. They are renewed, because they did not let their students suffer in frustration or not knowing how to cope with the distractions of IXL Math. The distractions will always be part of learning and are not solely a characteristic of mobile applications. It is up to the teachers to collaborate with other experts to understand the experiences of 2e students, because the standard training for teachers does not encompass the skills that allow teachers to understand the complexity of 2e students. The learning for teachers working with 2e students should be ongoing.

Future research

The research results showed a slight increase in achievement and self-efficacy when using IXL Math, although there is not sufficient data to show a statistical impact. One plan would be to conduct a longitudinal study of IXL Math and other mobile device applications to explore the impact achievement and self-efficacy of 2e students. The other potential foci of study are parent interviews and other mobile device applications. An additional study could be one that compares the use of mobile device applications by twice-exceptional (2e) students in settings with an individualized program to other types of settings, such as public school classrooms.

Conclusion

The IXL Math promised to be an adaptive learning tool, but it is limited and did not adapt to meet the social and emotional of each student. It is unclear that IXL Math played a role in the increase of achievement and self-efficacy of the twice-exceptional students in this study. IXL Math interfered in the learning experience of 2e students because the students were fixated on the SmartScore and other scoring features of the application. IXL Math's instant feedback often created social and emotional struggles for students, but the low teacher to student ratios with trained teachers to support the social and emotional needs of 2e students was an important factor in supporting students through challenging experiences. It is clear that it is the role of the teacher to support the social and emotional challenges of 2e students when using mobile applications. Also, it is important that teachers realize the benefit of reaching out to therapeutic experts or other experts in the field to support their work in the classroom.

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Appendix A: University of Houston IRB Approval

UNIVERSITY of HOUSTON
DIVISION OF RESEARCH

Institutional Review Boards
APPROVAL OF SUBMISSION

August 23, 2016

Ms. Jeanette Salinas,
Curriculum and Instruction

Dear Ms. Jeanette Salinas,

The IRB has reviewed the following submission:

Type of Review:	Full
Title of Study:	Achievement and Efficacy of Twice Exceptional (2e) Students Using a Mobile Device Application
Investigator:	Ms. Jeanette Salinas
IRB ID:	7729 - 16442-01
IRB Coordinator	Samoya Copeland

The IRB approved the study from:

- Approval Date: 8/22/2016
- Expiration Date: 8/21/2017

As required by federal regulations governing research in human subjects, research procedures (including recruitment, informed consent, intervention, data collection or data analysis) may not be conducted after the expiration date.

Sincerely,

Office of Research Policies, Compliance and Committees (ORPCC)
University of Houston, Division of Research
(713) 743-9204
cphs@central.uh.edu
http://www.uh.edu/research/compliance/irb-cphs/

Appendix B: Research Site Approval Letter

June 2, 2016

Dr. Lorraine Reitzel, Chair

Committees for the Protection of Human Subjects

316 E. Cullen Building
Houston, TX 77204

RE: Research Study Letter of Support of Josephine Jeanette Salinas research proposal

Dear Dr. Lorraine Reitzel:

I am writing on behalf of [redacted] in response to a request to obtain approval for proposed research by Josephine Jeanette Salinas enrolled at the University of Houston.

As a co-founder and current board member, I give full support for the research proposal entitled *Achievement and Efficacy of Twice Exceptional (2e) Students a Mobile Device Application* to be conducted on the campus of [redacted]. I am fully aware that students, teachers and clinicians will be recruited to participate in the study.

Please do not hesitate to contact me with any questions.

Sincerely,

[redacted]

Co-Founder & Board Member

Appendix C: Patterns of Adaptive Learning Scales (PALS) Subscale

Academic-Related Perceptions, Beliefs, and Strategies Academic Efficacy

The first question is an example.

I like strawberry ice cream.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

Directions: The following are questions about yourself as a student in this class. Please circle the number that best describes what you think.

1. I'm certain I can master the skills taught in class this year.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

2. I'm certain I can figure out how to do the most difficult class work.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

3. I can do almost all the work in class if I don't give up.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

4. Even if the work is hard, I can learn it.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

5. I can do even the hardest work in this class if I try.

1	2	3	4	5
NOT AT ALL TRUE		SOMEWHAT TRUE		VERY TRUE

Appendix D: Observation Data Collection Form

Observer	Location	Date	Time

Criteria	Observer Notes	Researcher Reflections
Description of the Setting of the Classroom Related to Instruction		
Participants 1. Male 2. Female 3. Description of each		
Lesson Activities 1. Lesson Design 2. Academic Objectives 3. Instructional Strategies 4. Assessments		
Social/emotional Objectives 1. Strategies to engage students 2. Responses from students		
Conversations Related to Instruction *1.* Student – Student *2.* Student – Teacher *3.* Teacher – Teacher		
Other Factors Related to Instruction *1.* Nonverbal Responses 2. Unplanned Activities		
1. Researcher Behavior *2.* Reaction of Others *3.* Location of Researcher		

4. Participation in Activities		

Appendix E: Teacher Interview Protocol

IXL Math: A membership-based math site that offers each student individual learning plans set by the teacher to learn, practice, and master state mathematics standards and concepts.
Self-Efficacy: The belief of capable behaviors or actions to produce an outcome.
Topic 1: Background questions

1. How long have you worked at this school?
2. What grade level do you teach in math?
3. How long have you taught?
4. How effective do you think the math standards are for grade levels you teach?
5. Do you feel that the math textbook that you are using is appropriate for students in your classroom who are identified as twice-exceptional? Why or why not?
6. How do you differentiate instruction in math for students in your classroom identified as twice-exceptional?
7. Tell me about the strategies or supportive techniques you use with students in your classroom who are identified as twice-exceptional.
8. What math resources would you like to have in the classroom to better support twice-exceptional students in the classroom?
9. How do you use assessments in the classroom to measure performance in the math?
10. Describe how you have developed skills to work with students identified as twice-exceptional.

Related Research Question:

What are the perceptions of a students, teachers, and clinicians when addressing achievement and self-efficacy of twice-exceptional students using mathematics mobile application?

<u>Topic 2: Student's self-efficacy during math.</u>
Lead off (Start off) question
Tell me about a typical math class.
Covert categories

- Teacher's understanding of self-efficacy.
- Teacher's understanding of behaviors or actions, which indicate self-efficacy or the lack of self-efficacy.
- Teacher's awareness of intervention methods for supporting students who exhibit signs of low self-efficacy.

Follow up questions

- Describe a time when a student struggled during math class.
- Describe words or actions used to support a struggling student complete the assignment.
- Describe how point system affects a student during the use of IXL Math.
- Describe a time when a student received an incorrect answer while using IXL Math.

- Describe a time when a student received a correct answer while using IXL Math.

Related Research Question:

What are the perceptions of a students, teachers, and clinicians when addressing achievement and self-efficacy of twice-exceptional students using mathematics mobile application?

Topic 3: Student achievement when using IXL Math.

Lead off (start off) question

Describe the use of IXL Math during math class

Covert Categories

- Student use of IXL Math to individualize and differentiate instruction.
- Student preparation to meet learning goals and objectives.
- Teacher understanding of techniques to prepare students for the use of IXL Math.

Follow-up questions

- Describe ways you transition students to math preparing them for the use of IXL Math.
- Explain how preparation affects students when using IXL Math
- Explain how you use IXL Math supports individualizing and differentiating instruction.

Appendix F: Clinician Interview Protocol

IXL Math: A membership-based math site that offers each student individual learning plans set by the teacher to learn, practice, and master state mathematics standards and concepts.
Self-Efficacy: The belief of capable behaviors or actions to produce an outcome.
Topic 1: Background questions

11. How long have you worked at this school?
12. How long have you worked with ages 5-13 children?
13. How long have you been a licensed clinician?
14. How effective do you think the math standards with the students you work with and observe?
15. Do you feel that the math textbook that you are using is appropriate for students in your classroom who are identified as twice-exceptional? Why or why not?
16. What ways do you think are best suitable for teachers to use when giving instruction in math?
17. Tell me about the strategies you use to support teachers in the classroom who are identified as twice-exceptional.
18. Tell me about the strategies you use to support students in the classroom who are identified as twice-exceptional.
19. Tell me about the strategies you use to support parents in the classroom who are identified as twice-exceptional.
20. Describe how you have developed skills to work with teachers to support students identified as twice-exceptional.
21. Describe how you have developed skills to work with students to support students identified as twice-exceptional.
22. Describe how you have developed skills to work with parents to support students identified as twice-exceptional.

Related Research Question:

What are the perceptions of a students, teachers, and clinicians when addressing achievement and self-efficacy of twice-exceptional students using mathematics mobile application?

<u>Topic 2: Student's self-efficacy during math.</u>
Lead off (Start off) question
Tell me about your experience observing a math class.
Covert categories

- Counselor's understanding of self-efficacy.
- Counselor's understanding of behaviors or actions, which indicate self-efficacy or the lack of self-efficacy.
- Counselor's awareness of intervention methods for supporting students who exhibit signs of low self-efficacy.
- Counselor's awareness of intervention methods for supporting teachers who exhibit signs of low self-efficacy.
- Counselor's awareness of intervention methods for supporting parents who exhibit signs of low self-efficacy.

Follow up questions

- Describe a time when a student struggled during math class.
- Describe words or actions used to support a struggling student complete the assignment.
- Describe how point system affects a student during the use of IXL Math.
- Describe a time when a student received an incorrect answer while using IXL Math.
- Describe a time when a student received a correct answer while using IXL Math.

Related Research Question:

What are the perceptions of a students, teachers, and clinicians when addressing achievement and self-efficacy of twice-exceptional students using mathematics mobile application?

<u>Topic 3: Student achievement when using IXL Math.</u>

Lead off (start off) question

Describe the use of IXL Math during math class

Covert Categories

- Student use of IXL Math to individualize and differentiate instruction.
- Student preparation to meet learning goals and objectives.
- Teacher understanding of techniques to prepare students for the use of IXL Math.

Follow-up questions

- Describe ways you train teachers to transition students to math in preparation for them using a mobile device application.

Explain how preparation affects students when using IXL Math

Appendix G: Parental Permission

UNIVERSITY of HOUSTON
A CARNEGIE-DESIGNATED TIER ONE PUBLIC RESEARCH UNIVERSITY

PROJECT TITLE:

Achievement and Efficacy of Twice-Exceptional (2e) Students Using Mobile Device Applications

Your child is invited to take part in a dissertation research project conducted by Jeanette Salinas from the Department of Education: Curriculum & Instruction at the University of Houston. The project is being conducted under the supervision of Dr. Susan Day.

NON-PARTICIPATION STATEMENT

Your child's participation is voluntary and you or your child may refuse to participate or withdraw at any time without penalty or loss of benefits to which your child is otherwise entitled. If your child chooses not to participate, then he/she should not sign the form. If your child chooses to withdraw from the study, then he/she should tell their teacher and your child's data will not be used in the study. Your child may also refuse to answer any question.

POST COLLECTION

If you choose to withdraw use of your child's data after post collection, you may contact the principal investigator at (713) 269-0757 or via email at jjsalinas3@uh.edu.

PURPOSE OF THE STUDY

The purpose of the study is to support educators identify tools to increase achievement and self-efficacy. The study will last four weeks. Achievement data from IXL Math usage reports and Adaptive Diagnostic Assessment Mathematics (ADAM) will be analyzed for achievement in this study. Self-esteem assessment will be used to analyze efficacy in this study.

PROCEDURES

Your child will be one of approximately 5 subjects to be asked to participate in this project.

Your child will spend approximately 30 minutes using IXL Math each day for four weeks, which will be approximately 10 hours. IXL Math offers math skills aligned to Texas Essential Skills and Knowledge (TEKS) through visual

representations, word problems, interactive activities and more. The IXL Math offers a practice tool that rewards hard work, encourages students to learn from their mistakes and challenges them with unlimited questions that offer a scaffold approach to learning mathematical concepts. Further information can be obtained at www.ixl.com.

Prior to the implementation and after the four weeks, your child will be assessed using the Adaptive Diagnostic Assessment of Mathematics (ADAM). This will take approximately 3.5 hours for before and after the four weeks lasting approximately 7 hours. IXL usage reports and the assessment will be used to analyze achievement.

The Patterns of Adaptive Learning Scales (PALS), a 5 question scale, will be administered to your child at the beginning and end of the four week IXL mathematics implementation. The PALS assessment will be used to analyze efficacy.

The mobile devices used will be provided to each student to be used at the school for the duration of the study, and must be returned to the school at the end of the study. The total time commitment will be approximately 17.5 hours. All activities will take place at school during school hours. Your child will not have to take work home for this project.

I will conduct four classroom observations within the four weeks of administration of IXL Math. I will spend no more than 45 minutes each week observing for verbal cues, non-verbal cues, behavior and engagement. Grades and achievement results will be used as part of the data for the study.

Your child's classroom teacher will be interviewed as part of the study in regards to their perception of the use of IXL Math in the classroom. Your child's family consultant will also be interviewed as part of the study in regards to their perception of the use of IXL Math.

SCHOOL RECORDS

[redacted] will provide academic and social/emotional reports to identify age, gender, ethnicity, grade level, academic and social/emotional standing. Previous grades, assessments, and/or reports will be used identify students for the purpose of this study. The name of students or any other identifying information will not be used for the purpose of this study. Grades, achievement reports, and assessment results from IXL Math, ADAM and PALS will used to analyze data for the duration of the study.

CONFIDENTIALITY

Every effort will be made to maintain the confidentiality of your child's participation in this project. Each subject's name will be paired with a code number by the principal investigator. This code number will appear on all written materials. The list pairing the subject's name to the assigned code number will be

kept separate from all research materials and will be available only to the principal investigator. Confidentiality will be maintained within legal limits.

RISKS/DISCOMFORTS

Potential risks include frustration, stress and/or boredom. Teachers will follow standard procedure to support your child with accommodations to complete assessments and IXL to minimize stress and discomfort. Furthermore, teachers will consult with the clinicians if support is needed beyond the scope of the training of the classroom teacher.

BENEFITS

Your child might feel more confident about his/her math ability, and/or he/she might feel like the IXL Math is supportive for learning math. When the research is completed, we hope to know more about math learning and feelings about learning math when using mobile device applications. This may help other children with who are bright and struggle in school. It is possible that there will be no direct benefit to students who participate in this study.

ALTERNATIVES

Participation in this project is voluntary and the only alternative to this project is non-participation. If your child does not participate in the project, then your child's data will not be used for the research project.

PUBLICATION STATEMENT

The results of this study may be published in dissertation research, professional and/or scientific journals. It may also be used for educational purposes or for professional presentations. However, no individual subject will be identified.

SUBJECT RIGHTS

1. I understand that parental consent is required of all persons under the age of 18 participating in this project. I understand that my child will also be asked to agree to participate.

2. All procedures have been explained to me and I have been provided an opportunity to ask any questions I might have regarding my child's participation.

3. Any risks and/or discomforts have been explained to me.

4. Any benefits have been explained to me.

5. I understand that, if I have any questions, I may contact Jeanette Salinas at ([redacted] school number. I may also contact Dr. Susan Day, research committee member, [redacted]

6. I have been told that my child or I may refuse to participate or to stop his/her participation in this project at any time before or during the project. My child may also refuse to answer any question.

7. ANY QUESTIONS REGARDING MY CHILD'S RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UNIVERSITY OF HOUSTON COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (713-743-9204).

8. All information that is obtained in connection with this project and that can be identified with my child will remain confidential as far as possible within legal limits. Information gained from this study that can be identified with my child may be released to no one other than the principal investigator and Dr. Susan Day. The results may be published in scientific journals, professional publications, or educational presentations without identifying my child by name.

NAME OF CHILD _____

I agree to allow my child to participate in this research project:

YES_____ NO_____

Signature of
Parent/Guardian:_____

Appendix H: Oral Assent Script

Project Title: Achievement and Efficacy of Twice-Exceptional (2e) Students Using a Mobile Device Application
Primary Investigator(s): Salinas, Jeanette Ms.
Research Committee Member: Day, Susan Dr.

ORAL ASSENT SCRIPT

You are invited to take part in a dissertation research project conducted by Jeanette Salinas from the Department of Education: Curriculum & Instruction at the University of Houston. The project is being conducted under the supervision of Dr. Susan Day.

You can say no if you do not want to participate in this study. Adults cannot make you participate in this study if you do not want to. If you agree to participate in the study now, but change your mind about it later, you can stop being in the study, and no one will be mad at you.

We want to talk to you about a research study we are doing. A research study is a way to learn information about something. We want to learn about students learning and feelings about learning when using mobile device applications in math class.

Research is a way to learn information about something. Researchers study different subjects the way you study English or math as a subject in school. There are many reasons people choose to be in a research study. Sometimes people want to help researchers learn about ways to help people or make programs better. You can ask and your teacher any question you have about the study.

If you agree to participate, you will complete a math feelings worksheet, which should take you about 5 minutes. At the beginning and at the end of the four weeks, you will take a multiple choice math test that will take approximately 3.5 hours each time. You can take breaks during at any time. Then, you will spend four weeks using IXL Math during math class approximately 30 minutes a day. After the four weeks, you will complete a math feelings worksheet and a multiple choice math test. All of these activities will occur while at school. You will not have work to take home from this project. The researcher will use grades to find out how you did in math prior to the study. The researcher will use grades, worksheet results and answers for the study. The mobile devices used will be provided to each student to be used at the school for the duration of the study, and must be returned to the school at the end of the study.

You might become frustrated or overwhelmed when completing the worksheets or tests for the study. Your teachers will support you during the math feelings worksheet and math skills test. The work and assessment you complete will be held confidential and not shared with classmates or adults other than your teachers who will support you through each task.

You might feel more confident about your math ability, and/or you might feel like the IXL Math was supportive for learning math. When we finish the research we hope we know more about math learning and feelings about learning math when using mobile device applications. This may help other children with who are bright and struggle in school.

You do not have to join this study. It is up to you. You can say okay now, and you can change your mind later. All you have to do is tell us. No one will be mad at you if you change your mind.

If you choose not to participate in this project, then do not sign the form. If you decide midway through the project not to participate, then tell your teacher and your work will not be used for the project. If you choose not to answer a question, then do not answer the question and leave it blank. All participants will be asked to take part in the research project as a standard school activity. The data of-participants that decide not to participate will not be used in the research project. If you choose not to participate at any time, your grade will not be harmed.

Before you say yes to joining this study, any questions you have will be answered.

Appendix I: Assent to Participate in A Research Study Age 6-9

This form will be READ by the Clinical Coordinator.

PROJECT TITLE:

Achievement and Efficacy of Twice-Exceptional (2e) Students Using Mobile Device Application

PRINCIPAL INVESTIGATOR INTRODUCTION
You are invited to take part in a research project conducted by Jeanette Salinas from the Department of Education: Curriculum & Instruction at the University of Houston. The project is being conducted under the supervision of Dr. Susan X Day.

You can say no if you do not want to participate in this study. Adults cannot make you participate in this study if you do not want to. If you agree to participate in the study now, but change your mind about it later, you can stop being in the study, and no one will be mad at you.

WHAT IS RESEARCH?

Research is a way to learn information about something. Researchers study different subjects the way you study English or math as a subject in school.

There are many reasons people choose to be in a research study. Sometimes people want to help researchers learn about ways to help people or make programs better.

You can ask and your teacher any question you have about the study.

WHY ARE WE DOING THIS RESEARCH?

In our research we want to learn about students learning and feelings about learning when using mobile device applications in math class.

WHAT WILL HAPPEN DURING THE STUDY?

You will complete a math feelings worksheet, which should take you about 5 minutes. At the beginning and at the end of the four weeks, you will take a multiple choice math test that will take approximately 3.5 hours each time. You can take breaks during at any time. Then, you will spend four weeks using IXL Math during math class approximately 30 minutes a day. All activities will take place at school during school hours. You will not have to take work home for this project. After the four weeks, you will complete a math feelings worksheet and a

multiple choice math test. The researcher will use grades to find out how you did in math prior to the study. The researcher will use grades, worksheet results and answers for the study. The mobile devices used will be provided to each student to be used at the school for the duration of the study, and must be returned to the school at the end of the study.

COULD GOOD THINGS HAPPEN TO ME FROM BEING IN THIS STUDY?

You might feel more confident about your math ability, and/or you might feel like the IXL Math is supportive for learning math. When the research is completed, we hope to know more about math learning and feelings about learning math when using mobile device applications. This may help other children with who are bright and struggle in school. It is possible that there will be no direct benefit to students who participate in this study.

COULD BAD THINGS HAPPEN TO ME FROM BEING IN THIS STUDY?

You might become frustrated or overwhelmed when completing the worksheets or tests for the study. Your teachers will support you during the math feelings worksheet and math skills test. The work and assessment you complete will be held confidential and not shared with classmates or adults other than your teachers who will support you through each task.

DO I HAVE OTHER CHOICES?

If you choose not to participate in this project, then do not sign the form. If you decide midway through the project not to participate, then tell your teacher and your work will not be used for the project. If you choose not to answer a question, then do not answer the question and leave it blank. All participants will be asked to take part in the research project as a standard school activity. The data of participants that decide not to participate will not be used in the research project. If you choose not to participate at any time, your grade will not be harmed.

WHAT IF I HAVE QUESTIONS?

I understand that, if I have any questions, I may contact Jeanette Salinas [redacted] school number. I may also contact Dr. Susan Day, research committee member, [redacted]

If you wish to talk to someone else or have questions about your rights as a participant, call the University of Houston Committee for the Protection of Human Subjects at (713) 743-9204.

DOCUMENTATION OF PARTICIPANT'S ASSENT

I agree to participate in this study called: Achievement and Efficacy of Twice-Exceptional (2e) Students Using a Mobile Device Application

Printed name of minor participant:
_____
Date: _____

ANY QUESTIONS REGARDING MY RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UNIVERSITY OF HOUSTON COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (713-743-9204). ALL RESEARCH PROJECTS THAT ARE CARRIED OUT BY INVESTIGATORS AT THE UNIVERSITY OF HOUSTON ARE GOVERNED BY REQUIREMENTS OF THE UNIVERSITY AND THE FEDERAL GOVERNMENT.

Appendix J: Assent to Participate in A Research Study Ages 10-14

PROJECT TITLE:

Achievement and Efficacy of Twice-Exceptional (2e) Students Using Mobile Device Application

PRINCIPAL INVESTIGATOR INTRODUCTION
You are invited to take part in a dissertation research project conducted by Jeanette Salinas from the Department of Education: Curriculum & Instruction at the University of Houston. The project is being conducted under the supervision of Dr. Susan Day.

You can say no if you do not want to participate in this study. Adults cannot make you participate in this study if you do not want to. If you agree to participate in the study now, but change your mind about it later, you can stop being in the study, and no one will be mad at you.

WHAT IS RESEARCH?

Research is a way to learn information about something. Researchers study different subjects the way you study English or math as a subject in school.

There are many reasons people choose to be in a research study. Sometimes people want to help researchers learn about ways to help people or make programs better.

You can ask and your teacher any question you have about the study.

WHY ARE WE DOING THIS RESEARCH?

For this project, I want to learn about students learning and feelings about learning when using mobile device applications in math class.

WHAT WILL HAPPEN DURING THE STUDY

You will complete a math feelings worksheet, which should take you about 5 minutes. At the beginning and at the end of the four weeks, you will take a multiple choice math test that will take approximately 3.5 hours each time. You can take breaks during at any time. Then, you will spend four weeks using IXL Math during math class approximately 30 minutes a day. All activities will take place at school during school hours. You will not have to take work home for this project. After the four weeks, you will complete a math feelings worksheet and a multiple choice math test. The researcher will use grades to find out how you did in math prior to the study. The researcher will use grades, worksheet results and

answers for the study. The mobile devices used will be provided to each student to be used at the school for the duration of the study, and must be returned to the school at the end of the study.

COULD GOOD THINGS HAPPEN TO ME FROM BEING IN THIS STUDY?
You might feel more confident about your math ability, and/or you might feel like the IXL Math is supportive for learning math. When the research is completed, we hope to know more about math learning and feelings about learning math when using mobile device applications. This may help other children with who are bright and struggle in school. It is possible that there will be no direct benefit to students who participate in this study.

COULD BAD THINGS HAPPEN TO ME FROM BEING IN THIS STUDY?

You might become frustrated or overwhelmed when completing the worksheets or tests for the study. Your teachers will support you during the math feelings worksheet and math skills test. The work and assessment you complete will be held confidential and not shared with classmates or adults other than your teachers who will support you through each task.

DO I HAVE OTHER CHOICES?

If you choose not to participate in this project, then do not sign the form. If you decide midway through the project not to participate, then tell your teacher and your work will not be used for the project. If you choose not to answer a question, then do not answer the question and leave it blank. All participants will be asked to take part in the research project as a standard school activity. The data of-participants that decide not to participate will not be used in the research project. If you choose not to participate at any time, your grade will not be harmed.

WHAT IF I HAVE QUESTIONS?

I understand that, if I have any questions, I may contact Jeanette Salinas [redacted] school number. I may also contact Dr. Susan Day, research committee member, [redacted]

If you wish to talk to someone else or have questions about your rights as a participant, call the University of Houston Committee for the Protection of Human Subjects at (713) 743-9204.

DOCUMENTATION OF PARTICIPANT'S ASSENT

I agree to participate in this study called: Achievement and Efficacy of Twice-Exceptional (2e) Students Using a Mobile Device Application

Signature of minor participant:
_____

Date: _____

ANY QUESTIONS REGARDING MY RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UNIVERSITY OF HOUSTON COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (713-743-9204). ALL RESEARCH PROJECTS THAT ARE CARRIED OUT BY INVESTIGATORS AT THE UNIVERSITY OF HOUSTON ARE GOVERNED BY REQUIREMENTS OF THE UNIVERSITY AND THE FEDERAL GOVERNMENT.

Appendix K: PALS Pre-Post Data

PALS Data (Pre)					
Prompts	William	Lucas	Kyle	Chris	Grace
I'm certain I can master the skills taught in class this year.	3	3	4	3	4
I'm certain I can figure out how to do the most difficult class work.	2	5	2	2	3
I can do almost all the work in class if I don't give up.	3	1	5	4	4
Even if the work is hard, I can learn it.	4	3	5	4	3
I can do the hardest work in this class if I try.	2	5	4	2	2

PALS Data (Post)					
Prompts	William	Lucas	Kyle	Chris	Grace
I'm certain I	4	5	2	5	4

can master the skills taught in class this year.					
I'm certain I can figure out how to do the most difficult class work.	3	1	4	4	2
I can do almost all the work in class if I don't give up.	5	5	4	5	5
Even if the work is hard, I can learn it.	4	5	4	3	5
I can do the hardest work in this class if I try.	2	5	3	4	4