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Teacher and Student Perceptions of Computer-Assisted Instructional Software to Differentiate Instruction

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2017

Abstract

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MA, Walden University, 2009

BS, Valdosta State University, 2007

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Many educators struggle to meet the academic needs of students, especially in the subject area of mathematics. Computer-assisted instruction is an instructional strategy used to enhance instruction. However, there is limited research on the effectiveness of these software programs for all students. The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within a general education and special education 4th-grade mathematics classroom. The constructivism theory provided a framework for the topic of differentiated instruction. This study included a single elementary school within a district in the Southeastern United States. The participants of this study included 1 general education and 1 special education 4th-grade mathematics teacher. In addition, participants included 6 general education and 4 special education 4th-grade mathematics students. Introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, 6 classroom observations, and teacher lesson plans were used as data collection methods. Gerund coding, categorizing, and content analysis was employed to interrogate the data. The constant comparative method was used to determine within-case and across-case themes and discrepancies. The findings revealed that teachers used computer-assisted instructional software, MobyMax, to meet individual student needs, monitor student progress, implement small group instruction, increase student engagement, and supplement primary teacher-led instruction. Educators can use the findings of this study to understand how teachers can use computer-assisted instruction to meet the needs of students.

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Dedication

I dedicate this study to my wife, Nichole Cannon.

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Chapter 1: Introduction to the Study

Educators are expected to differentiate instruction. This instructional strategy requires the teacher to possess an understanding of the academic needs and interests of students. Educators must design instruction that satisfies the individual needs of students. Although using technology to teach mathematics is often merely drill and practice, much of the latest software is more engaging. According to Dempsey and Kuhn (2011), technology can be used to enhance instruction. However, there is limited research on how effective these software programs are for all students (Thomson, 2010).

Differentiated instruction has the potential to aid both general education (GE) and special education (SPED) teachers. Differentiated instruction is relevant in education because this model focuses on modifying instruction to meet the individual needs of all students (Tomlinson, 2005). A student is not required to have an individualized education plan (IEP) to be eligible to receive differentiated instruction. However, differentiated instruction can assist special education teachers in meeting the needs and requirements of a student's IEP. The findings of this study may provide educators with a better understanding of how computer-assisted instructional software meets the needs of students of varying ability levels.

Background

General education is not general at all as classrooms now include GE students and students with special needs. This type of classroom is known as an inclusion classroom. Differentiated instruction is an effective strategy to use in inclusion classrooms to meet the needs of all students (Patterson, Conolly, & Ritter, 2009). However, meeting the needs of students of varying ability levels within the confines of one classroom is difficult.

In order to satisfy the unique learning styles and needs of students, educators must be informed of all resources available to differentiate instruction. Tomlinson (2009) noted that educators are continually seeking ways to increase the academic achievement of students with varying ability levels. Use of computer-assisted instruction is increasing at all levels of education. According to Spector, Merrill, Merrienboer, and Driscoll (2008), "Given the widespread use of computers to support learning and the growing use of handheld devices, it seems quite natural to treat the exchange of information between humans and the computers with which they interact as a distinct area" (p.25).

Differentiating reading instruction is commonplace; but targeted learning in mathematics is far less common (Smith & Turner, 2012). If educational technology can help meet the needs of mathematics learners educators should be implementing it into mathematics instruction (Dempsey & Kuhn, 2011). It is for this reason that I found the perceptions of fourth grade mathematics teachers and students to be imperative.

Problem Statement

In this qualitative embedded, multiple case study, I explored the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. Vigdor (2013) stated that "concern about our students' mathematics achievement is nothing new, and debates about the mathematical training of our nation's youth date back a century or more" (p. 42). The United States has faced a mathematics achievement deficit. In 2013, only 41% of fourth grade public school students performed at or above proficient in mathematics (National Center for Education Statistics, 2013). There is a need to better understand how to meet the individual needs of students in the content area of mathematics.

In 2013, Georgia's mathematics scores were in the bottom half nationally. Georgia students scored higher than students in 11 states but lower than students in 24 states in fourth grade mathematics (Governor's Office of Student Achievement, 2013). There is a deficit in the mathematics scores for the state of Georgia, especially in fourth grade mathematics. In this study, teacher and student perceptions of differentiated instruction were chosen for evaluation for two reasons. The first reason is that differentiated instruction has the potential to remediate weak skills of struggling students. The second reason is that differentiated instruction has the potential to enrich instruction for advanced students. The two reasons above are examples of how differentiated instruction meets the needs of varying ability levels.

A review of the literature was conducted for this study. The literature review included studies on teacher perceptions of using computer-assisted instruction. The literature review also included many quantitative studies on student achievement and student attitudes of computer-assisted instruction in mathematics. Vigdor (2013) reported that "Recently published results from policies such as Chicago's 'double dose' of algebra, which groups students homogeneously and increases instructional time for lower-skilled mathematics students support differentiation as the best way to promote higher achievement among all students" (p. 42). However, the literature did not include studies on teacher and student perceptions of computer-assisted instruction software programs as differentiated instruction tools. The lack of research regarding the teacher and student perceptions of computer-assisted instructional software and differentiated instruction provided a significant gap in the literature. The discovery of this gap in the literature provided significance for this study.

Purpose of the Study

The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. According to Spector et al. (2008), “Given the dynamic nature of learning and instruction and the introduction of new technologies and forms of communications, it is unlikely that this research area will ever be exhausted” (p. 25). Due to the academic lagging of Georgia fourth grade mathematics students, the participants for this study included one GE fourth grade mathematics teacher and one SPED fourth grade mathematics teacher. The participants also included six GE fourth grade mathematics students and four SPED fourth grade mathematics students.

This qualitative study provided a deeper understanding of how teachers and students used computer-assisted instruction to differentiate instruction during a year-end review unit. Observational data were collected to better understand teacher and student interactions with computer-assisted instruction. In the literature review for this study, I present the instructional benefits to using computer-assisted instruction and differentiated instruction. Even though research yielded benefits to using differentiated instruction, not all educators implement this instructional strategy regularly. Although differentiated instruction aids educators in meeting the needs of students, questions still exist about why some teachers do not embrace differentiated instruction (Tomlinson, 2009). The introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, six classroom observations, and teacher lesson plans yielded data that provided a deeper understanding of the issues noted above.

Research Questions

The following research questions were constructed based on the tenets of case study research and the current gap in the literature.

Central Research Question

How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?

Related Research Questions

1. How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
2. How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
3. How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?

Theoretical Framework

Dewey's (1938) constructivism theory was chosen as the theoretical framework for this study. The constructivism theory was selected because it provides a framework for the topic of differentiated instruction. The constructivism theory encompassed the key components of computer-assisted instruction and differentiated instruction. Constructivists describe the learning process that takes place through student interactions with their environment. In addition, constructivism includes a description of the importance of meeting the needs of all students. Tomlinson (2005) described differentiated instruction as modifying instruction to meet the individual needs of students. Instruction that allows a student to interact with environmental stimuli fuses constructivism theory and differentiated instruction by meeting the needs of individual students.

Nature of the Study

This qualitative study included an embedded, multiple case study method. A qualitative case study method was chosen due to its ability to conduct an in-depth exploration of a contemporary phenomenon in its real-world context (Yin, 2014). A case should be a real-life phenomenon that has some concrete manifestation (Yin, 2014). An embedded, multiple case study method was chosen for this study to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms.

This study included one elementary school within a district in the Southeastern United States. The multiple cases were one GE and one SPED fourth grade mathematics classroom. According to Creswell (2013), "No more than four to five cases should be included in a single case study. This number should provide ample opportunity to identify themes of the cases as well as conduct cross-case theme analysis" (p. 157). Further, the multiple embedded cases were used to explore literal replication logic.

In regards to participant selection, I purposefully selected two cases for this study using a criterion-based logic. Therefore, the teacher sample consisted of two fourth grade mathematics teachers. The criteria for selecting the teacher participants consisted of years of teaching experience and gender. The primary unit of analysis was the year-end review instructional unit. The subunits of analysis were the teachers and students. Finally, I conducted introductory and follow-up teacher interviews after regular school hours. The introductory interviews were primarily used to gain the trust of participants and access to their classrooms. However, both the introductory interviews and follow-up interviews were used to collect data to answer each research question.

I conducted introductory and follow-up focus group interviews as the student data collection method. Notably, I used focus group interviews to provide a more comfortable environment for the students. I also used the introductory student focus group interviews to introduce myself and to gain the trust of student participants. Moreover, I conducted the introductory student focus group interviews as the method to gain access into the classroom.

I invited all students in each teacher participant's mathematics classroom to participate in this study. However, I only received signed parent consent and student assent forms from six GE students and four SPED students. Therefore, I recruited a total of 10 student participants for this study. Further, I did not interview one GE student participant due to transportation issues. Thus, I included nine of the 10 student participants in the focus group interviews. Detailed information regarding participant selection is provided in Chapter 3.

I analyzed classroom observations and teacher lesson plans for data collection. I also included all 10 student participants in the classroom observations. In addition, I collected teacher lesson plans weekly. Detailed information regarding data collection procedures is provided in Chapter 3.

I used researcher bias, triangulation of data, and member checking as strategies to ensure credibility and dependability of research findings. Further, I reported the recommendations made by the teachers and students on ways to improve the implementation of MobyMax to better meet the needs of all students. Research findings for this study could assist teachers in using computer-assisted instructional software to achieve differentiated instruction and increase student learning.

Definition of Terms

The following terms were used frequently throughout the study.

Computer-assisted instruction: The use of computer or mobile technology to assist in classroom instruction (Hamilton, 2008). Modes of computer-assisted instruction include drill and practice programs, intelligent tutoring systems, simulations, and educational games (Grabe & Grabe, 2006).

Differentiated instruction: Modifying instruction to meet the individual needs of all students (Tomlinson, 2005).

Individual needs: The individual learning style and academic needs a student requires.

MobyMax: MobyMax is an individualized computer-aided instruction program. The Moby Max program is comprised of automatic placement tests, curriculum that is focused around individual education plans for each student, and is based on the common core standards (Brown & Johnson, 2014). The authors of the MobyMax program are MobyMax, LLC (2012).

Assumptions

I made three assumptions in this research study. The first assumption was that the student participants were capable of discussing their perceptions and experiences of working with MobyMax. Evidence to support using focus group interviews comprised of upper elementary students as a form of data collection is provided in Chapters 2 and 3. The second assumption was that the teacher and student participants responded honestly to all interview questions. This was imperative because the findings of this study were grounded in the perspectives of the teachers and students. The third assumption was that teacher and student behaviors and interactions during the classroom observations were accurate representations of any regular school day. This was also imperative to obtain a true picture of how teachers and students use computer-assisted instruction to meet the needs of all learners.

Scope and Delimitations

This qualitative embedded, multiple case study was conducted in an elementary school in the Southeastern United States. Based on the October 6, 2015 Georgia

Department of Education full-time equivalency report, the participating school district served 6,545 students in eight schools (Georgia Department of Education, 2015). Further, the research site for this study served 1,091 students (Georgia Department of Education, 2015). More specifically, the research site served 162 fourth grade students (Georgia Department of Education, 2015). Lastly, the fourth grade students were comprised of 85 female students and 77 male students (Georgia Department of Education, 2015).

This study was delimited to one GE and one SPED fourth grade mathematics teacher and six GE and four SPED fourth grade mathematics students. I chose a multiple case study design to explore literal replication logic (Yin, 2014). Two fourth grade mathematics classrooms were chosen as the two cases for this study due to the straightforward nature of Dewey's (1938) constructivism theory, differentiated instruction, and the literal replications derived from case to case. Yin (2014) maintained that "You may want to settle for two or three literal replications when your theory is straightforward" (p. 61).

Limitations

The data collected via this qualitative study were limited to one elementary school in the Southeastern United States. Therefore, the results of this study cannot be generalized to other schools and populations. The demographics of the students within the schools involved in this study may not correlate with the demographics of other districts. In addition, I reported on a year-end review unit, which may not be similar for other mathematical units taught in the fourth grade curriculum. Generalization of the research findings could be difficult based on the limitations listed.

A similar study may use a different computer-assisted instructional software program as the vehicle for that study. Numerous computer-assisted instructional software programs are available for purchase. In addition, one of the main weaknesses to using a qualitative study is the possible ethical issues that may arise during all phases of the research process. During qualitative research, researchers must establish supportive, respectful relationships without stereotyping and using labels that participants do not embrace (Bastedo, 2009). To reduce the impact of these limitations, an analysis of the introductory and follow-up teacher interview transcripts, introductory and follow-up student focus group interview transcripts, classroom observations, and teacher lesson plans were provided for this study. Additional limitations are reported in Chapter 5.

Significance

The results from this study could provide positive social change at the micro, macro, and mega levels. At the micro level, using technology to differentiate instruction could positively influence student perceptions of mathematics instruction. Positive social change could occur at the macro level by increasing graduation rates by satisfying students' individual needs through differentiated instruction. Lastly, positive social change could occur at the mega level by producing productive members of society who are experienced in using technology to acquire and apply new information. I believe this study advanced the profession of educational technology by reporting teacher and student perceptions of using technology to satisfy the academic needs of students. Lastly, the findings from this study provided additional support to the necessity and relevance of educational technology. Additional information regarding contributions of positive social change is provided in Chapter 5.

Summary

In Chapter 1, I introduced the topic of exploring teacher and student perceptions of using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. GE and SPED classrooms are filled with students of varying ability levels. It is imperative that educators understand the resources available to overcome the task of meeting the needs of all students. I provided evidence to support the problem and purpose statements for this study. Statistics for the academic achievement for Georgia fourth grade mathematics students were reported to support the problem statement.

The research questions were identified based on the review of literature. A theoretical framework based on Dewey's (1938) theory of constructivism was identified. This framework links differentiated instruction and the use of technology in education. The qualitative, embedded, multiple case study methodology was revealed. I discussed the key terms that were repeated throughout the study. The assumptions and limitations of the study were also listed. In Chapter 2, I provide a review of the literature on differentiated instruction and computer-assisted instruction.

Chapter 2: Literature Review

The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. Stanford, Flice, and Crowe (2010) reported that “Differentiated instruction with the use of technology offers the opportunity for teachers to engage students in different modalities, while also varying the rate of instruction, complexity levels, and teaching strategies to engage and challenge students” (p. 2). Chapter 2 includes the literature search strategy, theoretical foundation, literature review of differentiated instruction, literature review of computer-assisted instruction, and a synthesis of the frameworks and methods.

Literature Search Strategy

For this literature review, I used the Education Resources Information Center (ERIC), Education Research Complete, Academic Research Complete, Education Research Starters, Computers and Applied Sciences Complete, and the Education and Information Technology Library (EdItLib) when searching for articles. I used keywords such as *differentiation, differentiated instruction, elementary mathematics, computer-assisted instruction, individualized instruction, personalized learning,* and *constructivism*. Information on differentiated instruction, mathematics achievement, and constructivism were found in each database used. However, the majority of information found regarding computer-assisted instruction and MobyMax were found in the EDItLib database. In most cases, the search was limited to studies completed in the past 5 years.

Theoretical Foundation

A learning theory is comprised of three basic components. These components are the results, the means, and the inputs (Driscoll, 2005). The results are what is expected to change based on the theory. The means are the procedures in which the results are found. The inputs are what activate the processes to occur. Driscoll explained that the three components described above are the resources that structure the foundation for learning. Therefore, an instructional theory is described as the method that will best provide the conditions under which learning goals will be attained.

The learning theory is used to establish the connection between what is learned and the conditions in which learning occurs. Instructional theory includes intentional learning goals. This means that learning will occur when the conditions are favorable for learning to take place (Driscoll, 2005). Driscoll also explained that a learning theory and instructional theory must work in conjunction with one another. The primary difference between a learning theory and an instructional theory is that a learning theory explains how people learn and an instructional theory explains how learning takes place.

I selected the constructivism theory as the theoretical framework for this study. The constructivism theory is classified as an instructional theory because it explains how learning takes place (Dewey, 1938). I selected the constructivism theory because it provided a framework for the topic of differentiated instruction. In their study about the effectiveness of using differentiated instruction in mixed ability classrooms, Stavroula, Mary, and Leonidas (2011) emphasized that this strategy is based mainly on the theory of constructivism where the construction of knowledge emerges due to the active participation and interaction of students in the their environment.

Eisner (2004) focused on sensory differentiation that consists of students making distinctions based on various qualities they experience in their environment. Eisner's view is similar to the Dewey's (1938) constructivist theory. One component of differentiated instruction is modifying instruction to meet the needs of individual learners. Kinshuk (2012) stated, "Constructivist approaches in mainstream education have uncovered the realization that learning processes are more effective and successful when instruction is geared towards individual learners" (p. 561).

Dewey's (1938) ideas of progressive education are the foundation of the constructivism theory. Dewey also believed that learning should be based on students' experiences that are directed by the educator. Further, Dewey explained that educators must relate content to prior knowledge, experiences, and interests in order for the students to make connections to the content. Learning that is relative to everyday life will aid the development of a productive member of society.

Literature Related to Differentiated Instruction

Differentiated instruction is an effective instructional strategy that has become a priority by many educators throughout the United States. De Jesus (2012) described differentiated instruction by stating it is "the practice of modifying and adapting materials, content, student projects, and assessments to meet the learning styles of students" (p. 6). Differentiated instruction has a history in education. Educators have been differentiating instruction as long as the teaching profession has existed. Decades ago, teachers had students of multiple grade levels in one classroom. Educators were forced to implement differentiated instruction in order to teach a range of ages and ability levels. Differentiated instruction is an instructional framework used by educators to develop instruction and assessments to meet the learning styles, abilities, and interests of all students (Tomlinson, 2005). The primary focus of differentiated instruction is to personalize the student learning experience. Differentiated instruction breaks away from the traditional method of teaching and learning and such instruction can be teacher-led or student-led. Differentiated instruction also focuses on each individual student's learning preferences.

Differentiated instruction is a broad term comprised of many strategies to promote student learning. Lauria (2010) stated that differentiated instruction seeks to maximize each student's growth by recognizing that students have different ways of learning, different interests, different ways of responding to instruction, and preferred ways of learning or expressing themselves. Tomlinson (2005) stated there has been more information acquired about how students learn that justifies the need for differentiated instruction. This strategy includes, but is not limited to, student ability levels, student personal interests, learning styles, various types of assessments, and effective technology implementation.

Differentiated Instruction Strategies

Differentiated instruction encompasses a variety of strategies. A few of these strategies are formative assessment, tiered assignments, and personalized instruction by incorporating student interests. The prospect of rethinking teaching and learning often results in resistance when teachers consider developing and applying the principles and skills of differentiation (Tomlinson & Imbeau, 2012). In the subsequent paragraphs in this section, I present the current literature based on these three differentiated instruction strategies.

Formative assessment. The first strategy of differentiated instruction reported in this section is formative assessment. Peshek (2012) stated that formative assessment information is the foundation for instructional decisions about student readiness. Chinman, Imm, and Wandersman (2004) revealed how the immediate feedback of formative assessment is essential for the classroom teacher. Without effective progress monitoring and data collection, the teacher will have a difficult time identifying individual student needs. The individual needs of students are the foundation for differentiated instruction.

Tiered assignments. The second strategy of differentiated instruction reported in this section is tiered assignments. Educators are now required to document differentiated instruction strategies in their instructional plans. Shepherd and Acost-Tello (2014) described a “three-phase lesson” where differentiation strategies are considered during the planning stage. The teacher considers the prior knowledge students must possess to successfully participate and complete the lesson. The teacher also plans differentiation strategies to remediate or challenge students if needed. Finally, prior planning of the differentiation strategies makes the implementation process easier and more effective. The three-phase lesson is aimed to meet the needs of all students by addressing the core lesson, basic lesson, and enrichment lesson. The core lesson satisfies the needs of average students who already possess the prior skills and knowledge. The basic lesson includes remediation of missing or weak skills. The enrichment lesson includes critical thinking strategies and challenges the student to think more deeply about the content.

Personalized instruction. The third strategy of differentiated instruction reported in this section is personalized instruction. Educational technology is beginning to include more personalized, individualized, and differentiated instructional resources. Ku, Harter, Liu, Thompson, and Cheng (2007) compared the achievement and attitudes of 104 middle school students using a personalized and nonpersonalized version of computer-based instruction to solve two-step mathematics word problems. Students were randomly assigned to either the personalized or nonpersonalized computer-based instruction. The personalized computer-based instruction was created by using the student responses from a survey that was given on the computer. Information including student interests and preferences were used when creating the mathematics word problems for the personalized computer-based instruction. Davis-Dorsey, Ross, and Morrison (1992), Ku and Sullivan (2002), and Lopez and Sullivan (as cited in Ku et al., 2007) maintained that student performance can be improved by personalizing the information included in the word problems. In addition, Ku et al. explained that possible ways to personalize the word problems are to include personal interests and preferences. Ku et al. also revealed little significance between the students' achievement of the personalized CBI compared to the non-personalized CBI. Lastly, Ku et al. revealed that student attitudes were significantly more favorable for the personalized CBI compared to the nonpersonalized CBI.

One rationale for using digital technologies to personalize learning is that students are already creating personalized learning environments outside school and they should have the same opportunities at school (Hartnett & Edmunds, 2013). An example of digital technologies that personalize learning are intelligent tutoring systems that guide students through the learning process. Personalizing learning is one of the key components to successfully implementing differentiated instruction.

Recognizing and incorporating student interests is another strategy of differentiated instruction. Student interests are essential to designing and implementing quality instruction and promoting learning. Maloy, Razzaq, and Edwards (2014) used a multimedia tutoring system that offered fourth graders differentiated choices to aid their learning of problem solving strategies for mathematics word problems. Teachers often make decisions that determine how differentiation will be implemented in their instruction to satisfy student needs. The focus of their study was to allow students to make decisions to personalize their learning which successfully differentiated their instruction. The students were given a choice between four virtual tutors that presented the information from different viewpoints. The students could use one or more of the tutors to help develop their own understanding of the problem-solving strategies. This allows the student to take charge of their own learning and to personalize their learning experience by choosing the best delivery viewpoint for their learning style.

Benefits of Differentiated Instruction

Differentiated instruction is used to satisfy the individual needs of both regular education and special education students. De Jesus (2012) stated that differentiated instruction began with the adoption of the Individuals with Disabilities Education Act (1997) in order to satisfy the educational needs of students with disabilities within the confines of a general education classroom. In the subsequent paragraphs in this section, I present current literature based on the benefits of educational technology used to differentiate instruction.

A component of differentiated instruction involves student choice of instructional methods (Tomlinson, 2009). Burakgazi and Yildirim (2014) investigated fourth and fifth graders' use of mass media (TV, newspapers, Internet, and magazines) to assess their various features as sources for science learning. The data for this study were gathered using focus groups with purposefully selected students in four elementary schools. According to Burakgazi and Yildirim, "Twenty-three students from fifth-grade classes (14 girls, 9 boys) and 24 students from the fourth grade classes (12 girls, 12 boys) were selected for the focus groups, based on their experience with the phenomenon at hand" (p. 172). Burakgazi and Yildirim revealed that students were active in choosing and using media to meet their cognitive, affective, personal integrative, and social integrative needs.

Educational technology resources have the capacity to satisfy the learning styles of kinesthetic, visual, and auditory learners. McFarlane (2013) described mobile technologies as resources to satisfy differentiated instruction and personalized learning scenarios. Students are also able to engage with the technology and content at their own pace. Educational technology allows the students to engage and become interactive in the learning process. Espey and Brindle (2010) revealed the benefits of using student response systems (clickers) as formative assessment tools. When the students are using the clickers, they are actively engaged in the lesson. The student and teacher are able to receive immediate feedback of their progress. The ability to acquire these formative data in real time allows the teacher to remediate or provide enrichment for students during the lesson.

Scott, Rockman, Kuusinen, and Bass (2011) used an educational technology program that focuses on reading, writing, and mathematics. The participants were 127 fourth grade male and female students from four elementary schools. Two experimental schools and two control schools were chosen for the study. The effects of teaching and learning in the *Time To Know educational program* were compared to learning in a traditional setting. *The Time To Know educational program* is based on mathematics, reading, and writing curriculum. The students interacted with the *Time to Know educational program* via laptop computers. The program allows teachers to differentiate the curriculum provided for individual students. The teachers could provide content that had been adapted to the cognitive level of each individual student. The program included built in support that students can review if needed. The program produced real time progress monitoring and assessment reporting, which allowed teachers to immediately provide enrichment or remediate students. Scott et al. revealed that the *Time to Know educational program* contributed significantly to the fourth grade students' academic progress in reading, writing, and mathematics.

Technology can also be used to provide remediation and enrichment for students. Slaten, Rice, and Emfinger (2013) examined the effects of using technology to remediate at-risk kindergartners' learning. The study consisted of four kindergarten students who attended an afterschool program at a local community center. The researchers met with the participants twice a week for 1-hour intervals. These meetings took place during a 2-month period. The mathematics educational software program chosen in their study included a component that automatically determined areas of weakness for students based on a pre-assessment. The software program generated practice assignments based on the areas of weakness identified. While the students were engaged with the programs, the teachers took anecdotal notes based on the academic progress of the students and the effectiveness of the technology implementation. Slaten et al. indicated that the educational software programs were beneficial in remediating the missing or weak skills identified for the four kindergarten students. The major themes identified were interest in learning more about technology, motivation to learn, enjoyment in using technology, and improved self-confidence in themselves and their knowledge (Slaten et al., 2013).

Ebrecht and Ku (2015) investigated how three elementary teachers used classroom blogging as an instructional activity to support literacy instruction. The three elementary teachers were comprised of one third grade teacher, one fourth grade teacher, and one fifth grade teacher. Five students from each of the third, fourth, and fifth grade classrooms were chosen for the student focus group interviews. Six pragmatic benefits of classroom blogging were identified by the participants. The six pragmatic benefits correlated with differentiated instruction. The first benefit consisted of classroom blogging being a project-based, student-centered learning opportunity shown to increase student engagement and motivation. The second benefit was that classroom blogging promoted collaborative learning through the use of technology. The third benefit was that classroom blogging allowed the students the opportunity to write for an authentic audience. The fourth benefit was that classroom blogging imbedded readily into existing instruction. The fifth benefit was that classroom blogging offered students opportunities to practice essential literacy skills. Lastly, classroom blogging offered students the opportunity to attain and practice 21st century technology skills (Ebrecht & Ku, 2015).

Barriers of Differentiated Instruction

Educators must have a solid understanding of differentiated instruction to meet the needs of all students. Dixon, Yssel, McConnell, and Hardin (2014) described the mixed ability classrooms teachers are faced with today. Dixon et al. (2014) discussed the difficulty in meeting the needs of all students and how differentiated instruction plays an important role in making that task possible. The idea that a one size fits all approach to teaching is not effective, considering the diverse needs of each student was also explained. Implementing differentiated instruction in a school or classroom can be a tedious process. The subsequent paragraphs in this section reported the current literature based on the barriers that impede successful implementation of differentiated instruction.

Teachers are sometimes reluctant to embrace new instructional strategies that extend beyond the boundaries of their comfort zone. Tobin and Tippett (2014) conducted a qualitative study to examine teachers' perceptions of the possibilities and potential barriers when planning and implementing differentiated instruction in science. Tobin and Tippett explained that teachers are sometimes hesitant to embrace new instructional strategies due to lack of training or solid understanding of how to implement the strategy. Differentiated instruction requires a teacher to reflect on each individual student rather than an entire class. Recognizing the needs of each individual student can be an intimidating task for educators. Tomlinson (2005) maintained that teachers have to recognize students as individuals rather than an entire group.

Educators must possess a solid understanding of the curriculum they teach. Tomlinson (2005) noted that educators must possess a more in depth understanding of curriculum in order to effectively implement differentiated instruction. A more in depth understanding of the curriculum is necessary in order to modify instruction and assessment to meet the needs of individual students. Lessons and activities that require higher order thinking skills are often necessary for more advanced learners. However, struggling students might require lessons and activities that remediate weak and missing skills. If a teacher does not have a thorough understanding of the curriculum, it could be difficult to modify instruction and assessment effectively.

Classroom management is a necessity when implementing differentiated instruction. A differentiated classroom can consist of students in small groups working on various assignments. Callahan, Tomlinson, Moon, Brighton, and Hertberg (2005) discussed inflexible classroom management. When working in small groups, students are encouraged to facilitate learning by interacting with peers. The teacher becomes an observer during these situations. Because the students are not working under the direct supervision of the teacher, clear and precise rules must be established prior to small group instruction. Callahan et al. (2005) reported that teachers are often reluctant and fearful of relinquishing control of the classroom.

Literature Related to Computer-Assisted Instruction

Computer-Assisted Instruction is known as instruction that takes place by using a computer and software program. In addition, computer-assisted instruction presents opportunities to learn academic material at a child's instructional level (Brown & Johnson, 2014). Computer-assisted instruction is composed of many different instructional elements.

Modes of Computer-Assisted Instruction

Modes of computer-assisted instruction include drill and practice programs, intelligent tutoring systems, simulations, and educational games. These four examples of computer-assisted instruction are prevalent in 21st century classrooms. The subsequent paragraphs in this section report the current literature on each of the four modes of computer-assisted instruction.

Drill and practice. Drill and practice software programs are primarily used to increase fluency and/or automaticity of basic math facts. Mathematics fluency includes speed and accuracy. Skinner and Daly (2010) maintain that automaticity includes speed, accuracy, and utilizing little effort or cognitive processes. Drill and practice programs often include addition, subtraction, multiplication, and division facts. The student is usually given a set amount of time to answer the fact before the program generates the answer for the student to see. If the student answers the question correctly, the program will usually display an image to celebrate or congratulate the student for answering the problem correctly. Rewards are often used in these types of programs. Some drill and practice programs allow the students to earn points or badges.

Intelligent tutoring systems. The second mode of computer-assisted instruction are intelligent tutoring systems (ITSs) that were designed to allow students to receive individual support without increasing the workload of a teacher. Cobb (2010) maintained that differentiated instruction with internet-based software is the best method of teaching urban school students. Tutoring systems are developed with varying user interfaces. Tutoring systems with more sophisticated user interfaces are known as ITSs.

The more sophisticated interface allows the user to enter intermediate steps of a solution and to receive feedback on those steps rather than only entering a final answer. Some ITSs recognize that multiple methods or algorithms could be used to solve a particular problem, so these systems allow for more than one method to obtain a correct response. Research shows that one to one human tutoring is more effective than whole classroom instruction (VanLehn, 2011). However, VanLehn conducted a quantitative study that compared computer-tutoring systems to human tutoring for elementary learners. The results revealed the effect size of human tutoring to be d=0.79 and the effect size of intelligent tutoring systems to be d=0.76. This indicates that intelligent tutoring systems are nearly as effective as human tutoring.

Simulations and educational games. Simulations and educational games are intertwined throughout the literature. Many of the educational games created today use virtual simulations to engage the learner. According to Schrader and Bastiaens (2012), "Games can include visual stimuli, auditory stimuli, and support tactile sense" (p. 254). Digital games can immerse a user into a virtual world full of simulations where the user is forced to overcome challenges and hone their problem solving skills to advance through the game. Educational games also allow the user to engage in higher order thinking skills rather than games comprised of drill and practice situations (Schrader & Bastiaens, 2012).

Textbooks and lectures also began to take a backseat to educational technology like digital games and simulations. Gibson, Knezek, Redmond, and Bradley (2014) stated that digital games and simulations, "can achieve dramatically higher levels of emotional power, interactivity and effectiveness for learning compared to conventional resources such as books, lectures, videos, and student-produced artifacts such as reflection papers, student research, tests and quizzes" (p. 1). However, there are conflicting research studies on the effectiveness of digital game based learning on academic achievement. Tsai, Yu, and Hsaio (2012) noted that previous research supports that digital game based learning positively influences student motivation to learn, but does not fully reveal the power to increase student knowledge acquisition.

Interactive white boards (IWBs) are another mode of computer-assisted instruction. IWBs are a multipurpose tool that can be used for educational games, simulations, and many other forms of interactive technology. Smith, Higgins, Wall, and Miller (2005) conducted a study that examined the perceptions of students learning with IWBs in the content area of mathematics. Eighty sixth-grade students (46 boys and 34 girls) participated in the study. The students were engaged in learning with IWBs for one year. Student interviews were used as a data collection method. They found positive student perceptions of learning via IWBs in the content area of mathematics.

Finally, Sad and Ozhan (2012) conducted a qualitative phenomenological study to explore the perceptions of primary students regarding interactive whiteboard use in their classes. A phenomenological approach was chosen due to the investigation of lived experiences of the primary students regarding IWBs being used their classes for two years. Moreover, Sad and Ozhan's study aimed to evaluate the quality of instruction with IWBs by defining the strengths and weaknesses based on student perceptions. Data was collected from 50 primary students ranging from fourth to eighth-grade through focus group interviews. The results of their study revealed that students believed that instruction with IWBs positively impacted their learning especially because of visualization and contextualization, effective presentation, test-based use, and motivational factors.

Teacher Perceptions of Computer-Assisted Instruction

It is important to consider the role technology plays in education. Decades of research focused on whether computer-assisted instruction is more effective than instruction provided by humans. The literature revealed computer-assisted instruction has enhanced mathematics instruction; however, it has not replaced the expertise of an effective teacher (Anderson & Anderson, 2013). Therefore, computer-assisted instruction should not replace teacher-led instruction. Anderson and Anderson propose that educators must find ways to implement computer-assisted instruction to enhance their daily classroom instruction. The subsequent paragraphs in this section focus on teachers' attitudes and self-efficacy of implementing computer-assisted instruction.

Educators have mixed feelings about differentiated instruction and computer-assisted instruction. Proscia, Ulrich, Nicolino, and Morote (2010) conducted a quantitative study evaluating teachers' attitudes toward the use of computers in the classroom, differentiated instruction, and instructional technology. The 123 teachers surveyed in this study taught kindergarten through sixth-grade. The survey included four variables: the knowledge of differentiated instruction, the knowledge of instructional technology, the comfort level of differentiated instruction, and the comfort level of instructional technology. With respect to teachers' attitude toward the use of computers, attitude had a strong correlation with instructional technology but, had a negative correlation with a teacher's comfort level with differentiated instruction. The significance of the study was that teachers with a high comfort level with differentiated instruction reported a negative attitude toward use of computers in the classroom. This indicated that teachers who are advocates of differentiated instruction would not necessarily be more disposed to the use of computers in the classroom. Therefore, Proscia et al. (2010) revealed that teachers were less comfortable implementing differentiated instruction and more comfortable using instructional technology to support instruction.

In addition, Clark and Whetstone (2014) conducted a quantitative study that explored the impact of an online tutoring program, Math Whizz, on student mathematics achievement. Teachers were also surveyed regarding the implementation of the online tutoring program. Clark and Whetstone's study included 35 teachers from 15 elementary schools. The 15 elementary schools used the Math Whizz online tutoring programs as a supplement to mathematics instruction. Clark and Whetstone reported that teachers were provided with multiple professional development sessions regarding the program's implementation. The professional development consisted of ongoing training activities, online tutorials, an informational website, customer service, and technical support.

As previously mentioned, teachers were surveyed to determine their attitudes regarding the implementation of the online tutoring program, Math Whizz. The survey was comprised of 50 questions that explored the uses, implementation, and overall satisfaction with the program. The results from the teacher surveys indicated positive support regarding the implementation of Math Whizz. A total of 94% of teachers indicated they were satisfied or very satisfied with student progress, a total of 97% of teachers reported being satisfied or very satisfied with the curriculum of the Math Whizz program, and 97% of teachers reported that the curriculum of the Math Whizz program aligned with the present mathematics curriculum. In addition, 97% of teachers reported being satisfied or very satisfied with student enjoyment and 94% reported being satisfied or very satisfied with student enthusiasm for the Math Whizz online tutorial program. Clark and Whetstone (2014) reported that the findings of their study "suggest a high level of both teacher and student buy-in with regard to implementation of the Math Whizz system across the 15 elementary schools" (p. 464).

Implementation of technology in the classroom can be directly impacted by teacher experiences and attitudes. For this reason, it is imperative to understand the teacher experiences and attitudes toward technology. Kale and Goh (2011) conducted a quantitative study that examined teachers' experiences with the internet and examined their attitudes toward web 2.0 technologies. The participants consisted of teachers in all

13 middle and high schools in two counties in West Virginia. Data collection consisted of both paper and online surveys. The surveys consisted of Likert scale items. They reported positive attitudes toward web 2.0 technologies.

Teacher perceptions of technology can be impacted by their self-efficacy of implementation. Moore-Hayes (2011) conducted a study to evaluate the self-efficacy of pre-service and in-service teachers in regards to technology integration. The participants of this study consisted of 350 pre-service and in-service teachers. The participants completed a six-point Likert scale survey. They received a 40% response rate to the survey. The survey results revealed both pre-service and in-service teachers experienced feelings of low self-efficacy related to technology integration.

The understanding teachers have of web technology influences their perceptions and attitudes towards this type of technology. Lee and Tsai (2010) discussed the importance of teachers understanding how to use web technology to assist their instruction. A questionnaire known as the Technological Pedagogical Content Knowledge-Web Survey (TPCK-W) was used to examine teachers' self-efficacy of web-based instruction. The teacher participants for this study consisted of 558 teachers ranging from elementary to high school. The findings of their study revealed correlations between self-efficacy and positive attitudes to web-based instruction. Lee and Tsai reported that teachers with more years of teaching experience have lower confidence of using the Web and about how to integrate the Web into instruction. Also, Lee and Tsai reported "the results indicated teachers with more experience using the Web and Web-related instruction tend to have stronger self-efficacy regarding their TPCK-W, and display more positive attitudes toward Web-based instruction" (p. 16).

It is important to understand teacher perceptions of computer-assisted instruction for students of varying ability levels. Thomson (2010) conducted a mixed methods study that evaluated perceptions and experiences of teachers using computer-assisted instruction. Participants of this study included 28 instructors teaching at least one online course at an accredited learning center and research facility. The learning and research center's online program is designed to provide gifted students in grades 3-12 the opportunity to take online enrichment, high school honors, and advanced placement courses across a variety of subject areas. Thomson reported that 26% of the instructors taught enrichment courses for students in grades 3-5, 48% of the instructors taught enrichment courses for grades 6-8, and 82% of the instructors taught honors or advancement placement courses for students in grades 6-12. The content areas of the online courses consisted of English and writing, science, humanities and social sciences, mathematics, technology, and world language. Data collection from teachers consisted of individual interviews and an online survey. For the student population, six students consented and participated in individual interviews. In addition to individual interviews, an online survey was completed by 65 students. Thomson's study revealed that gifted students should be provided learning opportunities where they can be exposed to material beyond their grade level and advance through the curriculum at their own pace. Further, the results revealed that teachers and students felt the online environment provided a more individualized and differentiated learning experience for the students.

Teacher perceptions of technology can be influenced by the level of training and professional development they have received based on the new technology. Wilson and Wright (2011) described a study that evaluated 10 teachers' perceptions about technology integration and technology use in their classrooms. Hooper and Rieber's (1999) five phases of technology were used to categorize the teachers' perceptions. The five phases consist of familiarization, utilization, integration, reorientation, and evolution. The results of their study revealed that teachers who completed the five stages were the teachers that engaged students in using technology and continued their own professional development.

The literature reviewed in this section revealed positive and negative teacher perceptions of computer assisted instruction. Teachers with additional experience using technology reported more positive perceptions of computer-assisted instruction than teachers with limited experience using technology for instruction. Specifically, teachers demonstrated positive perceptions related to using computer-assisted instruction to monitor student progress and use of student data to drive classroom instruction. Hunter (2012) stated that teacher perceptions and student achievement are impacted by the type of computer-assisted instruction used and how effectively the teacher implements the technology. The impact of computer-assisted instruction on student achievement and attitudes are reported in the following section.

Student Achievement and Attitudes of Computer-Assisted Instruction

This section includes both student achievement and attitudes because many of the studies that evaluated student achievement also included student attitudes of mathematics. It is for this reason that student attitudes were included in this section.

Educators are continually looking for new ways to improve student attitudes toward learning. Mostly quantitative studies that evaluate the correlation between computer-assisted instruction and student achievement were found. The subsequent paragraphs include studies that used educational games and intelligent tutoring systems.

Educational games. The field of educational technology requires discussion and research about the overall effectiveness of technology in regards to student achievement and attitudes in the content area of mathematics. The additional research is necessary due to mixed results found in research studies. Hays (2005) conducted a meta-analysis of 274 articles based on the design, use, and evaluation of instructional games. Hays concluded there is no evidence that instructional games are the preferred method of teaching in all situations.

More recently, research indicates educational games have the potential to increase engagement of students. Therefore, when students are engaged in their work, their attitudes toward that work improve. Ritzhaupt, Higgins, and Allred (2011) conducted a quantitative quasi-experimental design to investigate the effects of educational game playing on middle school students' attitudes towards mathematics, mathematics self-efficacy, and mathematics achievement. The participants of Ritzhaupt et al.'s study included 225 middle school students from four Title 1 schools in two counties in the southeastern United States. The students participated in 16 weeks of game intervention that included one session of game play per week. The analysis of covariance (ANCOVA) revealed significant and positive changes in student attitudes towards mathematics and mathematics self-efficacy. However, there was no significant change in students' mathematic achievement (Ritzhaupt et al., 2011). The results indicated significant gains in student attitudes towards mathematics but no significant gain in mathematics achievement, which coincide with the results provided earlier in this section by Hays (2005).

As previously mentioned, educational games are one mode of computer-assisted instruction that show gains in student attitudes towards mathematics but no significant gain in mathematics achievement. Abrams (2008) conducted a mixed methods study that examined the effects of educational games on elementary and middle school students who were below grade level academically in the subject area of mathematics. The participants for this study included 33 urban elementary and middle school students. Participants were divided into an experimental group and a control group. The achievement of students in the experimental group was measured by comparing pre and post unit test results with students in the control group. The quantitative data did not support educational games for enhancing students' achievement. However, the findings for Abrams' study included questionnaire data that revealed an improvement of students' self-efficacy for learning mathematics, improving students' ability to receive mathematics instruction, and improving their interest in mathematical activities.

Intelligent tutoring systems. Another common mode of computer-assisted instruction is intelligent tutoring systems. Intelligent tutoring systems are computer-assisted instructional software programs designed to provide students with varying levels of individualized academic feedback and support. Research findings for intelligent tutoring systems are more favorable for student academic achievement than educational games.

Evidence that intelligent tutoring systems are favorable for increasing student achievement in mathematics is reported in a dissertation study by Baker (2014). Baker conducted a quantitative study examining the correlation between an intelligent tutoring system, Classworks, and student achievement on the state standardized Criterion Referenced Competency Test (CRCT). Data from 200 third grade CRCT scores, quizzes, and universal screener scores were collected for Baker's study. A multiple regression stepwise analysis was used to determine a correlation between variables. The students' quiz scores showed the strongest correlation to achievement on the state standardized test.

In addition, Hunter (2012) conducted a quantitative study that examined the effects of computer-assisted instruction on student achievement and student attitudes towards mathematics. The participants for this study were 62 middle school students. The students were divided into three groups receiving different types of instruction. The three instructional types were structured curriculum instruction, computer-assisted instruction, and computer-assisted instruction with structured curriculum instruction. The computer-assisted instruction used in this study was a program called Successmaker. Pre and posttest scores were used to determine the effect of treatment on mathematics achievement and attitude toward mathematics. A one-way analysis of covariance (ANCOVA) was used to measure the effects of instructional type on attitude toward mathematics.

Similarly, Lewis (2010) conducted a study using a quasi-experimental design to compare the academic performance of students exposed to traditional math instruction with or without the supplementation of a computer-assisted instructional software program, Successmaker. The participants for this study included 73 fourth grade students. Pre and posttests were used to measure student achievement. An analysis of covariance (ANCOVA) was used to measure the change in student achievement from pre to posttest. The results reported by Hunter (2012) and Lewis (2010) revealed an improvement in academic achievement and student attitudes towards mathematics.

Continuing the theme of improved academic achievement due to intelligent tutoring systems is reported in the following study, which focused on an educational mathematics program called the Waterford Early Math program. Shamir, Morris, and Johnson (2014) conducted a quantitative study to evaluate the effectiveness of the Waterford Early Math program for teaching preschool and kindergarten students' early math concepts. One hundred fourteen preschoolers and 56 kindergartners were selected to participate in this study. The treatment group used the program for 40 minutes per week for 28 weeks. The control group did not use the computer-assisted instructional program. The results of this study revealed that the use of the computer-assisted instructional programs has a positive impact on student mathematical gains (Shamir et al., 2014).

Computer-assisted instruction can be utilized to assist learning for a variety of students. Keengwe, Hussein, and Schnellert (2012) conducted a quantitative study including two schools with similar student demographics. The purpose of the study was to examine the relationship between computer-assisted instruction of English Language

Learner (ELL) students and other students with similar demographics that did not use the technology. One of the schools implemented computer-assisted instruction to supplement regular classroom instruction while the other school relied on traditional classroom lectures. Keengwe et al. reported that students used a computer-assisted classroom curriculum (CAC) for at least one hour per day. The CAC is supplementary to regular classroom instruction. Keengwe et al. did not reveal details about the CAC. The results revealed that students who used the computer-assisted instruction to supplement learning did significantly better than the students who relied solely on classroom lectures (Keengwe et al., 2012).

More research on the impact intelligent tutoring systems have on student achievement and attitudes is reported in the subsequent paragraphs. Notably, Ojalainen and Pauna (2013) conducted a quantitative quasi-experimental model that included an experimental group and control group. The experimental group consisted of 150 students with ages 16-19. The control group consisted of 32 students with ages 16-19. The experimental group engaged in learning with web-based mathematics exercises and the control group did their work from a textbook. Both groups completed a survey at the beginning and end of the course. The experimental group was also asked to answer questions about the usability of the web-based exercises. The main focus of their study was to evaluate the effects of web-based exercises in learning in relation to students' self-efficacy and learning achievements (Ojalainen & Pauna, 2013). The results revealed that web-based exercises could produce positive effects on learning. In addition, the students liked using the detailed feedback provided by the program and the support materials.

Moreover, Liu and Wu (2011) noted students' positive perceptions during learning in technology rich environments. They questioned whether the students' positive perceptions in technology rich environments were only a temporary effect. They conducted a quantitative study that examined the students' perceptions of constructivist technology integration (CTI) after their teachers had implemented the technology for nine months. Their participants consisted of 147 primary students who completed a validated questionnaire. The questionnaire consisted of four sections including enjoyment, assistance, effectiveness, and future technology use. A five-point Likert scale was used to rate each item on the questionnaire. Descriptive statistics and multiple regression analysis were used to analyze data collected. Both descriptive statistics and multiple regression analysis results revealed that students had positive perceptions of enjoyment, assistance, and effectiveness of CTI after nine months. The results also revealed that students often used technology in after school learning after CTI was implemented by teachers for nine months. Liu and Wu did not establish a clear definition for after school learning. It is unclear whether the after school learning took place in an after school program or at the children's home.

Further, Maloy, Razzaq, and Edwards (2014) conducted a study that examined the use of an online mathematics tutoring system in eight fourth grade classrooms. The online tutoring system, 4MALITY, was used for this study. The program includes four virtual coaches to help guide students through each problem solving approach. Each virtual coach represents a different problem solving approach. For example, Visual Vera offers a visual approach to solve a question. How to Hound offers strategic solutions, like rounding, estimation, or eliminating answers, to solve problems. Estella Explainer provides hints to solving problems and Chef Bear is a computational coach who solves problems using number operations. The participants consisted of 165 fourth graders. The students completed a pretest, practice session, and posttest based on the Massachusetts math curriculum. Maloy et al. (2014) reported a mean gain in academic performance of 25.51% from pretest to posttest. However, 36 student participants registered gains of 40% or more from pretest to posttest.

Likewise, Schoppek and Tullis (2010) conducted a quantitative study that explored the ability of individualized computer-assisted practice to enhance mathematics and word-problem solving skills. The computer-assisted software program, Merlin's Math Mill, was used for this study. A total of 113 students from four third grade classes in three elementary schools participated in this study. Of the 113 students, 57students volunteered to be the experimental group and the remaining 56 students became the control group. The results of their study were also in favor of the computer-assisted instructional software improving achievement of elementary students.

Finally, MobyMax was discovered only once during the research process. Brown and Johnson (2014) conducted a study that evaluated individualized computer instruction with a software program, MobyMax, on math assessment scores of middle grades students. The participants consisted of 95 seventh grade students. A mixed methods research design was utilized to collect data through surveys, curricular-based tests, formal and informal interviews, direct observations, and site documents. The results showed that MobyMax did positively affect student achievement. The results revealed that 58% of students thought MobyMax was enjoyable, fun, and motivating. In addition, 69% of students stated MobyMax allowed them to become more confident in their math skills. Brown and Johnson's (2014) study was the only study found that included the computer-assisted instructional software, MobyMax.

In conclusion, an overwhelming amount of research revealed a positive impact of computer-assisted instruction on student achievement and attitudes. More specifically, research based on intelligent tutoring systems reported more favorable gains in mathematics achievement than educational games. However, both intelligent tutoring systems and educational games were reported to increase student motivation and attitudes towards mathematics.

Synthesis of Frameworks and Methods

This section synthesizes the theoretical themes and methodological approaches common in the literature review. Many studies in the literature review pointed to using a constructivist theory in conjunction with computer-assisted instruction and differentiated instruction (Abrams, 2008; Baker, 2014; Hunter, 2012; Kale & Goh, 2011; Keengwe et al., 2012; Ku et al., 2007; Lewis, 2010; Maloy et al., 2014; Moore-Hayes, 2011; Proscia et al., 2010; Ojalainen & Pauna, 2013; Ritzhaupt et al., 2011; Schoppek & Tullis, 2010; Scott et al., 2011; Shamir et al., 2011; VanLehn, 2011). Quantitative studies that evaluated the correlation between computer-assisted instruction and student achievement were found during the review of current literature. The computer-assisted instructional software provided scaffolding and feedback based on the student's level of understanding. Relating content to a student's prior knowledge is a primary component of constructivist theory (Dewey, 1938). The results of each study revealed an improvement in elementary students' academic achievement when exposed to computer-assisted instruction (Keengwe et al., 2012; Schoppek & Tullis, 2010; Scott et al., 2011; Shamir et al., 2011; VanLehn, 2011).

The literature review also included quantitative studies that evaluated both student achievement and student attitudes towards learning mathematics. The studies included the use of instructional software (Baker, 2014; Hunter, 2012; Lewis, 2010; Ojalainen & Pauna, 2013; Ritzhaupt et al., 2011), educational games (Abrams, 2008), and personalized curriculum (Ku et al., 2007; Maloy et al., 2014). The utilization of instructional software, educational games, and personalized information gathering all related to student interests. Another important component of constructivism is the relation of content to student interests and experiences in order for the student to make connections to the content (Dewey, 1938). The studies noted in this paragraph produced mixed results in regards to student achievement but all reported positive student attitudes towards learning mathematics.

In addition, quantitative studies were identified that focused on teacher attitudes towards using computer-assisted instruction (Kale & Goh, 2011; Moore-Hayes, 2011; Proscia et al., 2010). Dewey (1938) was able to foresee the benefits of an educational setting where students facilitate the learning process and teachers monitor and guide the learning experience. The studies noted in this paragraph described the importance of evaluating teacher attitudes and self-efficacy towards using computer-assisted instruction, as this affects the teacher's ability to monitor and guide the student learning experiences.

The studies produced mixed results regarding teacher attitudes and self-efficacy towards using computer-assisted instruction.

The literature review also included four qualitative studies that explored the use of computer-assisted instruction (Burakgazi & Yildirim, 2014; Ebrecht & Ku, 2015; Sad & Ozhan, 2012; Slaten et al., 2013). A commonality among the studies was the exploration of student interests and engagement due to implementation of various modes of computer-assisted instruction. The results for each of the four qualitative studies all reported positive attitudes and engagement of students when engaged in the computer-assisted instruction. Lastly, with the exception of Slaten et al. (2013), the additional three qualitative studies (Burakgazi & Yildirim, 2014; Ebrecht & Ku, 2015; Sad & Ozhan, 2012) all utilized elementary student focus groups as a method of data collection.

Finally, three mixed methods studies were reported in the literature review (Brown & Johnson, 2014; Thomson, 2010; Smith et al., 2005). The mixed methods studies varied in regards to participants included and purpose of the study. The first study solely focused on student perceptions of using computer-assisted instruction and was the only study that utilized Vygotsky's (1978) social constructivism theory as the framework (Smith et al., 2005). Computerized coding of student focus group interviews, observational data, and an online student attitude questionnaire were used for data collection and analysis. The second mixed methods study examined both student perceptions and academic achievement of using computer-assisted instructional software (Brown & Johnson, 2014). Student interviews, direct observations, and site documents were used for data collection. The third mixed methods study examined teacher and student perceptions of using computer-assisted instructional software (Thomson, 2010). Teacher and student interviews were used as data collection methods.

All three mixed methods studies (Brown & Johnson, 2014; Thomson, 2010; Smith et al., 2005) began data analysis by using initial results from teacher and student interviews to identify broad categories. Some of the common categories were teacher perceptions of teacher-student interaction while using computer-assisted instruction, teacher perceptions of student interactions with computer-assisted instruction, teacher perceptions of student-student interaction while using computer-assisted instruction, and student perceptions of using computer-assisted instruction. The categories were broken down into individual statements to identify themes that are more specific. The common themes were found based on identifying positive, negative, and neutral comments from interview and survey data. The results of the qualitative data from the mixed methods studies varied among teacher and student perceptions of using computer-assisted instructional software. As noted by Brown and Johnson (2014); and Thomson (2010), the utilization of computer-assisted instructional software to meet the needs of individual learners correlates directly with Dewey's (1938) constructivist theory.

The framework and methods synthesis revealed both Dewey's (1938) constructivist theory and Vygotsky's (1978) social constructivism theory. However, Vygotsky's (1978) social constructivism theory was identified specifically in a study focusing on communication between a teacher and students using computer-assisted instructional software (Smith et al., 2005). Since the majority of studies in the literature review focused on students individually engaging with computer-assisted instructional software, which limits the teacher-student and student-student communication while using the software, the constructivist theory was the dominant theme derived from the framework and methods synthesis in regards to computer-assisted instruction and differentiated instruction. These instructional strategies emphasize the importance of centering instruction on individual student needs (Dewey, 1938; Tomlinson, 2005). The common themes for the theoretical framework, qualitative data collection, and analysis were used to determine the research design for this qualitative study. Chapter 3 explains these components in more detail.

Summary

This chapter identified the purpose of the study. The purpose of this study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate classroom instruction within two fourth grade mathematics classrooms. After the purpose statement, the search strategy that was used to collect the current literature was described. The databases and keywords used in the study were stated. Then, a theoretical framework based on Dewey's (1938) theory of constructivism was identified. Constructivism clearly linked differentiated instruction and the use of technology in education. Additional theories were provided to justify the constructivism theory. Finally, a review and synthesis of the current literature was provided. The review of literature provided a thorough examination of differentiated instruction and computer-assisted instruction. In chapter 3, I described the methodology, data collection, and data analysis strategies for this study.

Chapter 3: Research Method

The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. In this chapter, I present the research method I used to conduct this study. This chapter begins with a definition of a multiple case study design and the rationale for choosing this design. In terms of methodology for this study, I discuss the role of the researcher, participant selection, data collection instruments, procedures for recruitment, participation, data collection, and the data analysis plan. I also discuss issues of trustworthiness and ethical procedures that were used to conduct this study. A computer-assisted instructional program, MobyMax, was used as the vehicle for this qualitative, embedded, multiple case study. This instructional program was implemented by a school district in Georgia during the 2013-2014, 2014-2015, and 2015-2016 school years. MobyMax was renewed for the 2016-2017 school year.

Scholars have supported the use of differentiated instruction as an effective instructional tool and how the use of technology can enhance differentiated instruction. However, there is a deficit in mathematics achievement among fourth grade students in Georgia. The evidence listed above justifies the purpose for this study.

MobyMax

MobyMax is an individualized computer-assisted instruction program (Brown & Johnson, 2014). The MobyMax program is owned and operated by Learn Without Limits, LLC. The author of the MobyMax program is MobyMax, LLC. MobyMax is comprised of automatic placement tests, curriculum that is focused around individual education plans for each student, and is based on the common core standards. MobyMax covers the content areas of mathematics, reading, language arts, writing, science, and social studies. This instructional tool was designed to provide remediation for weak skills and enrichment by incorporating subsequent skills as a student progresses through the program. In this study, teachers used MobyMax to supplement instruction by providing remediation and enrichment for students of varying ability levels.

In addition to mathematics placement tests, automated practice assignments, drill practice of mathematics facts, and state test preparation assignments, the MobyMax program includes an application that allows students to select from a variety of games. MobyMax allows students to earn game time based on the number of questions answered correctly. MobyMax can be accessed online; therefore, students can use computers, Chromebooks, or tablets to employ this program. MobyMax is not software that is loaded onto individual computers. MobyMax satisfies multiple learning styles by including visual and auditory explanations throughout lessons. This could engage 21st century learners by incorporating visual, auditory, and communication features on the new innovative technological devices, such as Chromebooks and tablets. Students possessing a computer and Internet access at home have the capability to work on MobyMax outside the confines of the school building. Finally, MobyMax has been a part of the standard curriculum for Holly Hills Elementary (pseudonym) for the past 3 years.

Research Design and Rationale

This was a qualitative study using an embedded, multiple case study method. The nature of the research questions for this study favored a descriptive case study design. Creswell (2013) affirmed that qualitative researchers seek to provide explanation of phenomena that occur in the world. Similarly, Yin (2014) maintained that "how" and "why" questions are more explanatory and likely to lead to a case study. These types of questions deal with operational links that can be explained.

In order to understand how something affects a person's life, qualitative researchers observe people's experiences in their natural setting and conduct in-depth interviews to gather information (Creswell, 2013). As described by Maxwell (2013), quantitative researchers see the world in terms of variables and seek to demonstrate that there is a statistical relationship between different variables. Further, Maxwell noted that "qualitative researchers see the world in terms of people, situations, events, and the processes that connect these; explanation is based on an analysis of how some situations and events influence others" (p. 29). Yin (2014) described qualitative research as providing rich description of the nature of a phenomenon. Researchers have conducted quantitative, qualitative, and mixed methods studies when exploring computer-assisted instruction and differentiated instruction. However, few qualitative studies were found that focus on computer-assisted instruction as a differentiated instruction tool in elementary mathematics classrooms.

The qualitative tradition is comprised of five research designs: narrative inquiry, phenomenological, grounded theory, ethnographic, and case study. Researchers must select the research design based on the purpose of their research study. A phenomenological research design and case study design were both considered for this study. A phenomenological research design is used to describe the lived experiences of individuals in relation to a phenomenon (Creswell, 2013). However, the purpose of this study was not to describe the lived experiences of teachers and students based on their use of computer-assisted instruction and differentiated instruction in the classroom. The purpose of this study was to explore teacher and student perceptions of using computer-assisted instruction to differentiate instruction within two fourth grade mathematics classrooms. Therefore, a case study design was chosen for this study.

An embedded, multiple case study design was chosen to accomplish the purpose of this study. The case study approach is used to focus on the study of a case within a real-life context or setting (Creswell, 2013). Case study research is comprised of single case and multiple case study designs. The same study may contain more than a single case and when this occurs, the study has used a multiple case study design (Yin, 2014).

My initial research design included the recruitment of three fourth grade mathematics teacher participants. In addition, I planned to invite all students enrolled in each of the three teacher participants' classrooms to participate in this study. Details regarding my original plan for participant selection and a discussion of the optimal student focus group size are provided in the participant selection section of this chapter.

Further, I predicted that data collection would begin around the beginning of March 2016, which would be the onset of the multiplying fractions instructional unit. However, my plans changed because I only received consent to participate from two teacher participants. Due to data gathered via the introductory teacher interviews, I learned that the fourth grade mathematics teachers finished teaching the multiplying fractions unit. The teachers planned to begin the year-end review unit on April 11, 2016 and finish on May 6, 2016. Therefore, I modified my design and resubmitted all appropriate documents to Walden Institutional Review Board (IRB) on March 24, 2016. I requested to change the unit of analysis from the multiplying fractions unit to the year-end review unit. The request was approved by Walden IRB with the same initial approval number 03-14-16-0154180.

In order to provide evidence for the multiple case study design, I first defined the cases chosen for this study. I chose two fourth grade mathematics classrooms as the cases for this study. Yin (2014) noted that replication logic is analogous to that used in multiple experiments. Further, Yin maintained that "upon uncovering a significant finding from a single experiment, an ensuing and pressing priority would be to replicate this finding by conducting a second, third, and even more experiments" (p. 57). Therefore, the two cases for this study were used to explore literal replication logic. Additional details regarding the two cases for this study are provided in Chapter 4. Moreover, the primary unit of analysis was the year-end review instructional unit. Subunits of analysis were the teachers and students. Finally, the following research questions for this study were designed due to their relation to the theoretical framework, case study design, and gap in the literature.

Central Research Question

How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?

Related Research Questions

1. How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
2. How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
3. How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?

Role of the Researcher

As the sole researcher for this case study, I collected, analyzed, and interpreted all data. I explored teacher and student perceptions of using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. I aimed to be a good listener during each phase of data collection. Yin (2014) stated, "A good listener is able to assimilate large amounts of new information through multiple modalities without bias" (p. 74).

Every researcher has a personal perspective or lens through which a study is viewed. These perspectives are shaped by researcher interests, biases, and backgrounds.

Miles, Huberman, and Saldana (2014) discussed the difficulty for qualitative researchers to manage researcher bias due to the researcher being the primary data collection instrument. Yin (2014) noted one way to test possible bias is to understand the degree to which a researcher is open to contrary evidence. As previously mentioned, I acted as a good listener during the introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, and classroom observations. The teachers and students carried out most of the conversations which allowed for uninterrupted, rich discussion.

I also used the strategies of triangulation to avoid researcher bias. Data triangulation consisted of using multiple modes of data collection which provided corroborating evidence. The corroborating evidence from multiple sources provided validity to the research findings (Creswell, 2013). The multiple modes of data collection chosen for this study were introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and teacher lesson plans.

This research study was conducted in a Southeastern United States school district where I am currently employed. I was employed by this public school district for 9 years. The initial four years of my career were spent teaching fourth grade mathematics. I spent the last 5 years teaching third grade mathematics, science, and social studies. Even though I conducted this case study in the same school district in which I work, I selected a school where I have not been employed. In addition, the school I selected is located on the opposite side of the county from the school I am currently employed.

Participant Selection

There were four possible fourth grade mathematics teacher participants at Holly Hills Elementary. The teacher participants were selected based on two levels of criterion. The first set of criteria were the following: (a) participant must be employed as a teacher at the research site; (b) participant must hold a clear and renewable early childhood education teaching certificate, as required by the Georgia Professional Standards Commission; (c) participant must provide instruction for students enrolled in a fourth grade mathematics course at the site; and (d) participant must currently be using MobyMax in the fourth grade mathematics classroom. The second set of criteria were the following: (a) years of teaching experience and (b) gender differences. I e-mailed a letter of invitation and consent form (Appendix A) to all potential fourth grade mathematics teachers, identified by the principal, who met the selection criteria which were years of teaching experience and gender differences. The goal of the e-mail was to explain the purpose of the study. Details regarding teacher participant selection are provided in Chapter 4.

Next, I mailed an invitation/consent letter to all parents/guardians of students enrolled in each of the teacher participants' fourth grade mathematics classrooms. I also included an assent form for the students to sign under the direction of their parents/guardians. Finally, I only recruited students in each of the fourth grade mathematics classrooms who returned the parent/guardian informed consent and minor assent form in the self-addressed, stamped envelope to my home address to participate in this study. In Chapter 2, three qualitative research studies (Burakgazi & Yildirim, 2014;

Ebrecht & Ku, 2015; Sad & Ozhan, 2012) were described that used focus groups comprised of elementary students as a form of data collection, which validated the decision to select fourth grade students as participants in this study. In addition, Treadwell (2010) used focus group interviews as a data collection method for fifth grade students. The purpose of this mixed methods study was to determine whether discovery learning increased student writing achievement. Therefore, Treadwell also provided validity for the use of focus group interviews for upper elementary students.

In my original research design, I planned to ask the principal of Holly Hills Elementary to assign a number to each individual student in each of the fourth grade mathematics teachers' classrooms. I also planned to place the numbers in three groups ranging from low, average, and high ability levels based on each student's mathematics average on the most recent report card. Then, I intended to randomly select three low, three average, and three high ability students by drawing three numbers from each group. Therefore, even with a high rate of attrition, an adequate number of students would have been able to participate in the focus group interviews. Shaw, Brady, and Davey (2011) noted that six to eight participants are optimum for focus groups including children. The goal was to eliminate potential issues, such as student absences, on interview day. Due to a smaller number of fourth grade mathematics students consenting to participate in this study, I did not randomly select students for the focus groups. Details regarding student participant selection and student focus groups are provided in Chapter 4.

Further, student names were replaced with pseudonyms so their identity remained confidential. In addition, the introductory and follow-up student focus group interviews were conducted before and after regular school hours. Lastly, the introductory and follow-up teacher interview data and introductory and follow-up student focus group interview data were analyzed to explore the teacher and student perceptions of using computer-assisted instruction to differentiate instruction within two fourth grade mathematics classrooms.

Qualitative scholars often focus on smaller samples in order to gather more in-depth information from the participants. A small sample of participants was justified for this case because the goal of qualitative research was to provide a rich description of the phenomenon (Merriam, 2009). I purposefully selected the teacher and student participants based on the framework and methods synthesis reported in Chapter 2. According to Patton (2009), “Purposeful sampling focuses on selecting information-rich cases whose study will illuminate the questions under study” (p. 230). Purposeful sampling consists of the researcher evaluating a group of people that will divulge quality information rather than focusing on the quantity of people.

Instrumentation

Yin (2014) reported six sources of evidence most commonly used in case study research. The six sources included documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts. Multiple modes of data collection were imperative to achieve triangulation. Creswell (2013) stated that data collection tools should align with the purpose of the research and the research questions.

I designed four instruments for this study, which were the introductory and follow-up teacher interview questions and the introductory and follow-up student focus group interview questions. Classroom observation data were collected using a differentiated instruction classroom observation instrument created withTomlinson by Strategic Research, LLC (Appendix B). I e-mailed Dr. Tomlinson on January 4, 2016 to request permission to use this observation instrument. On January 8, 2016, Dr. Tomlinson returned my e-mail reply and granted me permission to use her differentiated instruction classroom observation instrument (Appendix C). Detailed information regarding data collection is provided in Chapter 4.

Principles of constructivism theory informed the design of the introductory and follow-up teacher interview questions and introductory and follow-up student focus group interview questions. Dewey's (1938) constructivism theory describes the importance of meeting the individual needs of all students. The instruments reported in this section were designed to explore how well MobyMax met the individual needs of all students. The introductory and follow-up teacher interview questions and introductory and follow-up student focus group interview questions were reviewed by three professionals to ensure validity. The instruments were reviewed by an educational research faculty member at Walden University, the superintendent of the same school district as the participating school, and a superintendent of a bordering school district of the participating school. The superintendents were chosen based on their deep knowledge of differentiated instruction and their experience of evaluating teachers in the area of differentiated instruction.

Teacher and Student Interviews

Teacher interviews. The design for the introductory and follow-up teacher interview questions and the introductory and follow-up student focus group interview questions was based on Yin’s (2014) guidelines to conducting interviews. Yin (2014) described the importance of both following the line of inquiry, as reflected by case study protocol and to ask conversational questions in an unbiased manner. Yin (2014) also noted that interviews are insightful and provide explanations, personal views, perceptions, attitudes, and meanings. The introductory and follow-up teacher interviews provided a rich description of how computer-assisted instruction was used in two fourth grade mathematics classrooms to differentiate instruction (Appendix D & Appendix E, respectively). I reported the teacher’s recommendations and explanations on ways to implement MobyMax to better meet the needs of all students. Interview questions were fully written prior to the interview. The introductory and follow-up teacher interview protocol followed a semi-structured format, which consisted of asking questions designed to obtain open-ended responses from all participants (Yin, 2014). The introductory and follow-up teacher interview protocol asked open-ended questions that reflected the research questions. The introductory and follow-up teacher interview questions addressed the following topics: (a) teachers’ experiences and opinions in using computer-assisted instruction to differentiate classroom instruction, (b) the benefits the teachers believed students received when they used computer-assisted instruction to learn mathematics, (c) the challenges the teachers believed students faced when using computer-assisted instruction to learn mathematics, and (d) recommendations on how teachers and students could better use computer-assisted instruction to meet the individual needs of all students.

Student focus group interviews. The introductory and follow-up student interview questions were asked within the context of a focus group (Appendix F & Appendix G, respectively). A focus group interview was used to provide a more comfortable environment for the students. The goal was for students to feel more comfortable participating in the company of their peers rather than one-on-one with an adult. The decision to use focus groups comprised of fourth grade students was validated by previous studies reported in the literature review and chapter 3 (Burakgazi & Yildirim, 2014; Ebrecht & Ku, 2015; Sad & Ozhan, 2012; Treadwell, 2010). The student focus group interviews addressed the following topics: (a) the students' experiences and opinions of using computer-assisted instruction to help them understand mathematical concepts, (b) the benefit students believed they received when using computer-assisted instruction to learning mathematical concepts, (c) the challenges students believed they received when using computer-assisted instruction to learn mathematical concepts, and (d) recommendations on how teachers and students could better use computer-assisted instruction to meet the individual needs of all students. I also aligned these questions with the research questions.

The introductory and follow-up teacher interviews and the introductory and follow-up student focus group interviews were audio recorded. I audio recorded the interviews so I could maintain focus on the participants. Audio recording also enables the researcher to produce accurate interview transcripts (Creswell, 2013). I constructed a table of alignment for the research and interview questions (Appendix H).

Classroom Observations

I collected data through six classroom observations during the instructional timeframe for teaching the year-end review unit. The classroom observation instrument used for this study was created with Carol Tomlinson by Strategic Research, LLC. During the observations, I used the classroom observation instrument to report the behaviors, level of engagement, and interactions between the teachers and students. More specifically, I documented how teachers interacted with the students and how the students interacted with the computer-assisted instructional software. I also made notes regarding communication among the teachers and students. The observation items noted above were imperative to explore how computer-assisted instruction was used to differentiate instruction and learning during a year-end review instructional unit.

Lesson Plans

Teacher lesson plans were analyzed as a source of data collection for this qualitative study. I used content analysis to analyze the lesson plans to better understand how the teachers implemented and utilized computer-assisted instruction into instructional planning to achieve differentiated instruction. Teacher lesson plans yielded valuable information regarding teacher perceptions of how computer-assisted instruction met the individual needs of the student participants. Teacher lesson plans also revealed whether the teacher utilized computer-assisted instruction for the purposes of instruction, assessment, or both. Most notably, the teacher lesson plans provided a concrete picture of how computer-assisted instruction was embedded in an entire mathematics instructional unit to meet the needs of all students. The overall picture of how computer-assisted instruction was embedded in an entire mathematics unit to meet the needs of students would be difficult to determine based solely on interview questions and observations. For this reason, teacher lesson plans were an important data collection method for this study.

Procedures for Recruitment, Participation, and Data Collection

In compliance to Walden University's Institutional Review Board (IRB) procedures for participant recruitment, I sent an e-mail to the associate superintendent in the cooperating school district to explain the purpose of this study and to request a signed letter of cooperation. The associate superintendent signed the district letter of cooperation (Appendix I) and I received the letter from her at the Board of Education on January 28, 2016. In addition, I sent an e-mail to the principal of Holly Hills Elementary school to explain the purpose of this study and to request a signed letter of cooperation (Appendix J). The principal of Holly Hills Elementary signed the school letter of cooperation and returned it to me via fax. I received the fax on January 28, 2016.

In terms of recruiting potential participants, I e-mailed the principal of Holly Hills Elementary to identify all fourth grade mathematics teachers who met the selection criteria previously reported in this chapter. After IRB approval, the principal provided a list of teachers who were currently using the MobyMax computer-assisted instruction program as part of the regular curriculum in fourth grade mathematics classrooms. For each teacher, I e-mailed a consent form to participate in this study, along with the purpose of the study and data collection procedures. If the teachers agreed to participate in the study, they sent a reply e-mail to me directly stating the words, “I consent.” I prepared a reminder letter to send to potential teacher participants if I did not hear back from them within two weeks (Appendix K). I received correspondence from all potential teacher participants within a few days. Therefore, I did not need to send out the reminder letter. I recruited two fourth grade mathematics teachers that met the criterion defined above. Thus, I was able to conduct a multiple case study as planned. Lastly, all consent, assent, and letters of cooperation included pseudonyms to replace participants’ names so their identity remained confidential.

In addition, I followed Walden University’s IRB procedures for student participant recruitment. I mailed a letter of invitation to all students in the selected teacher participants’ fourth grade mathematics classrooms. The letter of invitation was addressed to the parents/guardians of these students and included the purpose of the study and data collection procedures. I provided a consent form for parents/guardians to sign confirming their approval for their children to participate in introductory and follow-up student focus group interviews. I also included an assent form for the students to sign under the direction of their parents/guardians. In addition to the parent/guardian consent and student assent forms, I included a self-addressed stamped envelope for the parents/guardians to return the consent and assent forms.

All students who returned the parent/guardian informed consent and minor assent forms in the self-addressed, stamped envelope to my home address were selected for the classroom observations. However, the students who did not receive permission from their parents/guardians to participate in the classroom observations were not observed. The seating arrangement of all students was left entirely up to the teacher. Each teacher participant provided a seating chart of blocks for the desks. The teacher used the pseudonym assigned for each student to note where the participating students were sitting. This process allowed me to only observe students who had been granted permission in the least invasive way possible. The goal was for all students to participate in the classroom in their normal manner.

In relation to data collection, I conducted introductory and follow-up teacher interviews. The introductory and follow-up teacher interviews were held at the research site and lasted about 20 minutes. The introductory teacher interviews took place on March 21, 2016. Therefore, the follow-up teacher interviews took place at the conclusion of the year-end review instructional unit. The instructional timeframe for the year-end review unit was about six weeks.

During initial data collection, data was stored on a personal, password protected computer. The personal, password protected computer was stored in a locked file cabinet within my home. After completion of the study, electronic data was stored on a personal jump drive. The jump drive was stored in a personal, locked file cabinet within my home. The hardcopy paper documents were stored in a personal, locked file cabinet within my home. All data will be destroyed in five years as required by the Institutional Review Board (IRB) at Walden University. I will delete the audio recordings and electronic files of teacher interviews and student focus group interviews from the jump drive and then physically destroy the jump drive. Finally, I will shred all hardcopy documents.

Introductory and follow-up teacher interviews were held at Holly Hills Elementary in a private room with a door that was closed for privacy purposes. All interviews were conducted before or after regular instructional hours. I used a digital audio recorder to record the introductory and follow-up teacher interviews. The audio recording of interviews allowed me to produce accurate transcriptions immediately after the interviews. I transcribed the audio recordings on my personal password protected computer using Microsoft Word software.

I also conducted introductory and follow-up student focus group interviews. Introductory and follow-up student focus group interviews were held at Holly Hills Elementary in a private room with a door that was closed for privacy purposes. All interviews were conducted before or after regular instructional hours. The introductory student focus group interview took place on April 14, 2016, shortly after the onset of the year-end review unit. Therefore, the follow-up student focus group interview took place at the conclusion of the year-end review unit. I used a digital audio recorder to record the introductory and follow-up student focus group interviews. I transcribed the audio recordings on my personal password protected computer using Microsoft Word software. Lastly, I informed all parents of students selected for the focus group interviews by letter in the mail at least one week before the selected dates and times.

In addition to interview data, I collected data through six classroom observations throughout the year-end review unit. The first classroom observation took place on April 14, 2016, shortly after the onset of the year-end review unit. The second classroom observation took place on April 28, 2016, before the conclusion of the year-end review unit. During the observations, I used the observation instrument created with Carol Tomlinson by Strategic Research, LLC to report teacher and student behaviors, engagement, and interactions.

I acted as a nonparticipant observer during the observations. The nonparticipant observer role allowed me to take field notes of my observations without being directly involved with the activity of teachers and students (Creswell, 2013). The nonparticipant role also limited the potential distractions that I may have caused for the teachers and students. Further, the non-participant observer role allowed me to explore teacher and student behaviors, engagement, and interactions while using computer-assisted instruction.

Observations can be an important component of data collection in qualitative research. Observations allow the researcher to understand the context in which people interact. The researcher is able to have first-hand experience with the setting and could potentially identify things that are routine to the participants and may be taken for granted unless identified by someone from the group. There may be possibilities to observe behaviors that participants may be unwilling to talk about. Finally, the researcher uses information to form impressions that are invaluable to the study and cannot be replaced by the most detailed field notes (Patton, 2009).

In terms of documents, I collected data from teacher lesson plans. The teacher lesson plans provided insight on how the teacher incorporated computer-assisted instruction into classroom instruction to achieve differentiated instruction. The teacher lesson plans also included the standards and essential questions for the specific year-end review unit. I collected the lesson plans from the two teacher participants once a week during the instructional timeframe for the year-end review unit. I asked the teacher participants to e-mail me their lesson plans at my Walden University e-mail. I reviewed the teacher lesson plans at my home office.

Data Analysis Plan

I began analyzing data as soon as I began data collection from the teacher and student interviews, classroom observations, and teacher lesson plans. I began the data analysis process by listening to and transcribing the introductory and follow-up teacher interviews and the introductory and follow-up student focus group interviews. I studied the interview transcripts, observational notes, and lesson plan documents. Creswell (2013) described organizing, coding, and interpreting the data collected as the basic steps to all qualitative research.

Dewey's (1938) constructivism theory informed data analysis. Introductory and follow-up teacher interview transcripts, introductory and follow-up student focus group interview transcripts, observational data, and lesson plan documents were examined through the lens of constructivism theory to identify emerging categories and themes. According to Creswell (2009), researchers collect information from the participants and organize the data into categories or themes. The themes can generate broad patterns, theories, or generalizations that are compared with personal experiences or with existing literature about the topic. The themes and categories that become patterns, theories, or generalizations, help identify end points for qualitative studies. In case study research, the researcher summarizes interpretations. Creswell (2009) stated this combination is called naturalistic generalizations.

For this study, I utilized Charmaz's (2006) method of forming gerunds for coding. Charmaz (2006) noted that codes stick closely to the data and show actions. Further, Charmaz (2006) maintained that, "Through coding, you define what is happening in the data and begin to grapple with what it means" (p. 46). In addition, I analyzed data at two levels using the hand coding method. Miles et al. (2014) described the two levels as first cycle codes and second cycle codes or pattern codes. At the first level, I coded and categorized data from each source. I analyzed the introductory and follow-up teacher interviews and introductory and follow-up student focus group interviews by examining each individual question for similarities and differences. This initial stage in the coding process allows a researcher to narrow the data to a more convenient size. I read all transcripts of interviews, observations, and lesson plan analyses. I identified the most important categories. I used this method to construct categories from the codes.

At the second level, I read all data sources and highlighted repetitive words in the data. I reviewed the data collected a second time and highlighted words that were different, but had the same meaning. In addition, I used these repetitive words and meanings to derive several themes and any discrepant data. This type of coding is appropriate for virtually all qualitative studies but particularly for beginning qualitative researchers (Miles et al., 2014). The themes and discrepancies formed the key findings of the study. I used content analysis for the classroom observations. The content analysis focused on teacher and student behaviors, level of engagement, and interactions between teachers and students. Moreover, I used content analysis to analyze the teacher lesson plans to better understand how the teachers implemented and utilized computer-assisted instruction into instructional planning to achieve differentiated instruction. The key findings were then analyzed and interpreted based on the central and related research questions.

Table 1 includes the research questions for this study. In addition, the data collection source, timeframe, and analysis methods are identified for each corresponding research question. The data collection methods consisted of introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and teacher lesson plans.

Table 1

Summary of Data Collection Tools

Research Question	Data Source	Data Collection Timeframe	Data Analysis
RQ1: How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?	Teacher interviews Classroom observations Teacher lesson plans	Weeks 1 and 4 Weeks 2 and 4 Weeks 1-4	Coding, categorizing, and content analysis using hand coding
RQ2: How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?	Students' focus group interviews Classroom observations	Weeks 1 and 4 Weeks 2 and 4	Coding, categorizing, and content analysis using hand coding
RQ3: How does computer-assisted instructional software in two fourth grade mathematics classrooms provide	Teacher interviews Students' focus group interviews Classroom observations	Weeks 1 and 4 Weeks 1 and 4 Weeks 2 and 4	Coding, categorizing, and content analysis using hand

differentiated instructional opportunities for students?	Teacher lesson plans	Weeks 1-4	coding
Central RQ: How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?	Teacher interviews Students' focus group interviews Classroom observations Teacher lesson plans	Weeks 1 and 4 Weeks 1 and 4 Weeks 2 and 4 Weeks 1-4	Coding, categorizing, and content analysis using hand coding

Issues of Trustworthiness

Kaufman, Guerra, and Platt (2006), suggested that "valid and reliable data can be thought of as data that are, timely and up to date, supported by citations to the source, related to the questions posed by the evaluation, verifiable by independent sources, free of opinion and bias, and collected in an unbroken chain of events" (p. 88). Miles et al. (2014) noted four issues of trustworthiness. The four issues are credibility, transferability, dependability, and confirmability.

Credibility

The credibility strategies that were utilized for this qualitative study were triangulation of data and member checking. Triangulation of data was a strategy that was used to establish credibility and dependability of research data findings. Triangulation was achieved by collecting multiple modes of data. I analyzed introductory and follow-up teacher interview transcripts, introductory and follow-up student focus group transcripts, classroom observations, and teacher lesson plans. The use of multiple data collection methods, with different strengths and limitations, acted as a system of checks and balances to achieve triangulation of the data collected. Triangulation involves using various methods of data collection determine if a single conclusion can be derived (Maxwell, 2013).

Member checking was another strategy that was used to establish credibility of research data findings. I aimed to utilize the member checking strategy to ensure accuracy of introductory and follow-up teacher interview transcripts. I also reviewed classroom observation and lesson plan data collected and interpretations derived with the teacher participants. Creswell (2009) stated the process of reviewing data and interpretations of data with participants is invaluable.

Transferability

Transferability is the degree to which research findings of a qualitative study can be transferred to other settings. I aimed to use rich and thick descriptions to establish transferability. I audio taped and transcribed all interviews to produce detailed, rich data. In addition, I used field notes during the teacher and student observations. Maxwell (2013) suggested the rich, and thick descriptions of the data will provide sound grounding for, and test of, the conclusions of the study. Merriam (2009) also noted typicality of sample as another way to establish transferability. Typicality of sample is present when a researcher can describe how a case is typical compared with others in the same category. The proposed fourth grade mathematics classrooms for this study are typical of other fourth grade mathematics courses within this district and state.

Dependability

Dependability of a study involves determining whether the researcher’s approach is consistent and dependable among other researchers. An example of evaluating dependability would be whether or not two or more different researchers coded the same passage with similar codes. For this study, I utilized content specialists to review the interview questions. The content specialist evaluated each interview question and determined their relevance to the study during the review. I also utilized a content specialist to crosscheck codes developed to ensure consistency. Finally, I reviewed transcripts to make sure there were no errors made during transcription (Maxwell, 2013).

Confirmability

Confirmability is the degree to which the research findings of a qualitative study can be confirmed by other individuals (Miles et al, 2014). Reflexivity, a strategy to enhance confirmability, requires self-reflection of the researcher to identify potential biases that might affect the research study (Merriam, 2009). Creswell (2009) described how background, gender, culture, history, and socioeconomic origin could influence a researcher's interpretation of the findings. These are examples of researcher bias. As an elementary school teacher, I am evaluated on 10 standards. One of those standards was differentiated instruction; therefore, I made an earnest effort to document my differentiated instruction strategies in my lesson plans. Due to the use of differentiation in my daily instruction, I made notes of my own personal experiences and perceptions of differentiated instruction. Revealing my personal experiences and perceptions of differentiated instruction was an attempt to acknowledge possible bias.

Ethical Procedures

I obtained approval from Walden University's Institutional Review Board (IRB) to conduct this study. The Walden University IRB approval number is 03-14-16-

0154180. The subsequent items in this paragraph were completed to obtain approval from Walden University's IRB. First, I used e-mail to obtain approval for participation in this study from the district's associate superintendent. Secondly, I e-mailed the principal of Holly Hills Elementary school to obtain approval for participation in this study before contacting any potential teacher participants. Once approval was granted, I replied to the principal via e-mail to acquire a list of all fourth grade mathematics teachers employed at Holly Hills Elementary. Next, I e-mailed an invitation/consent form to all potential fourth grade mathematic teachers who met the selection criterion defined earlier in this chapter. Two teachers were selected to participate in this study. Lastly, I obtained approval from 10 parents/guardians of student participants via written consent and assent forms. All students in each of the teacher participants' classrooms were invited to participate in this study.

The consent form included an explanation of the purpose, confidentiality, and the use of results for the study. The participants were informed of their right of refusal to participate in the study. The participants were also informed of their right to withdraw from the study at any time. I did not offer any incentives for participation in this study. I assigned a pseudonym that identified the teacher participant and each student participant to protect their identity. I saved the data collected for this study to a flash drive and will destroy the data after five years. Finally, I invited the principal, teachers, parents/guardians, and student participants to a meeting where I revealed the findings of this study. The meeting was held at Holly Hills Elementary. In addition to revealing the findings of the study, I provided refreshments for all in attendance. I also disseminated a

2-3 page summary report of results, in addition to providing the face-to-face session. Lastly, I used this time to express appreciation to all participants and exit the study. Morrison, Gregory, and Thibodeau (2012) reported the obligation researchers have to engage participants in meaningful dialogue around closure.

Summary

The purpose of this qualitative embedded, multiple case study was to explore teacher and student perceptions of using computer-assisted instruction to differentiate instruction within two fourth grade mathematics classrooms. The study took place in an elementary school within the southeastern United States. A case study approach was chosen for this study to allow for introductory and follow-up teacher interviews and introductory and follow-up focus group interviews to explore the teacher and student perceptions of using computer-assisted instruction to differentiate instruction. Moreover, the introductory and follow-up teacher interview data, the introductory and follow-up student focus group interview data, classroom observations, and documents in the form of lesson plans were analyzed for data collection. Researcher bias, triangulation of data, and member checking were strategies that were used to ensure credibility, transferability, dependability, and confirmability of the research findings. The research findings for this study could potentially assist teachers in utilizing computer-assisted instructional software to achieve differentiated instruction. In chapter 4, I presented the data results derived from this study.

Chapter 4: Results

The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. To accomplish that purpose, I described how teachers used computer-assisted instruction in two fourth grade mathematics classrooms for differentiated instruction. I also described how teachers perceived the value of using computer-assisted instruction as a differentiated instruction tool in two fourth grade mathematics classrooms. Further, I described how students perceived the value of using computer-assisted instruction as a differentiated instruction tool in two fourth grade mathematics classrooms. Finally, I described how computer-assisted instructional software in two fourth grade mathematics classrooms provided differentiated instructional opportunities for students.

I used multiple data sources as a system of checks and balances to achieve triangulation. The data sources consisted of introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and teacher lesson plans. I analyzed the data collected from these sources to answer the following research questions:

Central Research Question

How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?

Related Research Questions

1. How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
2. How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?
3. How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?

In Chapter 4, I describe the setting, demographics, data collection, and data analysis procedures for this study. I explain how I coded and categorized the introductory and follow-up teacher interviews and student focus group interviews. In addition, I describe how I used content analysis for the classroom observations and teacher lesson plans. I include summary tables to report categories for all data sources. Then, I report the evidence of trustworthiness. The four issues of trustworthiness are credibility, transferability, dependability, and confirmability. Lastly, I report the results based on the central and related research questions.

Setting

I conducted this qualitative, embedded, multiple case study at Holly Hills Elementary in the Southeastern United States in 2015-2016. At Holly Hills Elementary, classroom teachers used the MobyMax program in addition to teacher-led classroom instruction. MobyMax was a part of the standard curriculum for the research site for the past3 years.

I received a letter of cooperation from both the school district associate superintendent and the Holly Hills Elementary principal prior to beginning data collection. I e-mailed the teacher consent form to all four fourth grade mathematics teacher participants on March 16, 2016. One GE fourth grade mathematics teacher and one SPED fourth grade mathematics teacher confirmed their consent to participate in this study via e-mail. I was surprised to learn that one of the four potential fourth grade mathematics teacher participants was a SPED teacher. The fact that one of the participants was a SPED teacher had no negative impact on this study. I was able to conduct within-case and across-case analysis. Additional information regarding each teacher participant is provided in the following demographics section.

Further, I obtained all parent/guardian contact information from each teacher participant. I mailed out all parent/guardian consent and student assent forms on March 21, 2016. I received consent and assent forms from four GE students and four SPED students by April 4, 2016. On April 8, 2016, I received a consent and assent form from an additional GE student. Per IRB approval, I allowed at least a 2-week timeframe for student recruitment. However, I extended the student recruitment timeframe in an attempt to increase the number of student participants. On April 16, 2016, I received the final student consent form from another GE student. The final student participant population was comprised of six GE students and four SPED students. The final student participants for this study consisted of all students who returned the parent consent and student assent forms.

The student participants for this study were recruited from two fourth grade SPED classes and one fourth grade GE class. The two fourth grade SPED classes were taught by the same SPED teacher participant. Both SPED classes were comprised of a small number of SPED students. Therefore, I recruited participants from both SPED classes to increase the number of SPED student participants for this study. Additional information regarding the 10 student participants is provided in the following demographics section.

Participant Demographics

There were four potential fourth grade mathematics teacher participants at Holly Hills Elementary. I used a purposeful sampling strategy to select participants for this study. The potential teacher participants were selected based on two levels of criteria. The first set of criteria was (a) participant must have been employed as a fourth grade mathematics teacher at the research site; (b) participant must have held a clear and renewable early childhood education teaching certificate, as required by the Georgia Professional Standards Commission; (c) participant must have provided instruction for students enrolled in a fourth grade mathematics course at the research site; and (d) participant must have consistently used MobyMax in the fourth grade mathematics classroom. The second set of criteria was (a) years of teaching experience and (b) gender differences.

One potential teacher participant declined to participate in this study due to limited use of the MobyMax program. A second potential teacher participant declined to participate in this study; however, the teacher did not provide a reason for declining the invitation. Two of the four potential fourth grade mathematics teacher participants consented to participate in this study. The first teacher participant, Mrs. Mary (pseudonym), had been teaching for 12 years. She was a GE fourth grade mathematics teacher at Holly Hills Elementary. The second teacher participant, Mr. Beau (pseudonym), had been teaching for 4 years. He was a SPED fourth grade mathematics teacher at Holly Hills Elementary. Pseudonyms were used to protect the identity of each participant.

Yin (2014) described the ability for a researcher to revise the cases, along with other facets of the research design, as a result of discoveries during data collection. Throughout data collection, Mr. Beau made no distinction between the two SPED classes he taught. In addition, he provided one lesson plan each week which revealed the same instructional planning for both classes. Yin also noted that the definition of a case is related to the way a researcher defines the research questions. I reflected on the research questions for this study. Mr. Beau used computer-assisted instruction the same way within both of his SPED classes, which yielded one perception of using computer-assisted instruction. Therefore, I chose to select two cases for this study. The multiple cases for this study were one general education class (Mrs. Mary) and one special education class (Mr. Beau). The unit of analysis for this study was the year-end review instructional unit embedded in these classes. The year-end review instructional unit included all fourth grade Georgia Mathematics Standards of Excellence.

The fourth grade Georgia Mathematics Standards of Excellence included the following domains: operations and algebraic thinking, number and operations in base ten, number and operations-fractions, measurement and data, and geometry. A range of standards within each domain were reviewed based on individual student needs. Standards were reviewed via MobyMax and teacher-led instruction. The MobyMax program was used to review standards in two ways. The teacher participants assigned certain lessons on MobyMax for individual students based on their needs. In addition, MobyMax automatically assigned students their lessons based on the results of their placement test. The measurement and data standards were reviewed due to a smaller percentage of these standards on the Georgia Milestones Assessment. The length of the year-end review unit was 6 weeks.

Lastly, there were 34 potential student participants combined between the one GE class and the two SPED classes. I recruited 10 of the 34 students to participate in this study. Of the 10 students, six were GE students and four were SPED students. Of the six GE students, three were male and three were female. Of the four SPED students, two were male and two were female. The six GE student participants were Darrell, Sarah, Griffin, Grace, Edward, and Helen, and the four SPED student participants were John, Bridgette, Diane, and Luke. I replaced all teacher and student names with pseudonyms to ensure their identity remained confidential. The teacher participants and all student participants had prior experience using the MobyMax program. Finally, the teacher participants and all student participants used the MobyMax program during the data collection phase of this study.

Data Collection Process

I collected data from multiple sources, which included introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and lesson plans. On March 21, 2016, I conducted the introductory teacher interviews after school hours at Holly Hills Elementary. I conducted each teacher interview in the school conference room for about 20 minutes. On April 14, 2016, I conducted the introductory SPED student focus group interview before school hours at Holly Hills Elementary. I conducted the introductory SPED student focus group interview in the school conference room for about 15 minutes. I decided to conduct the introductory SPED student focus group interview before school due to transportation issues for John and Diane.

Further, I conducted the introductory GE student focus group interview after school on April, 14, 2016. This interview lasted for about 15 minutes in the school conference room. I was only able to interview Darrell, Sarah, Griffin, and Grace from the GE class. I was unable to interview Edward due to transportation issues. With such short notice, I was unable to reschedule the interview because Darrell, Sarah, Griffin, and Grace made arrangements for their parents to pick them up after school. In addition, Helen's name was omitted from this list due to receiving her parent/guardian consent and student assent form after the introductory GE student focus group interview was conducted. Helen was only interviewed during the follow-up GE student focus group interview. I recorded all interviews using a digital voice recorder.

On April 14, 2016, I conducted the first classroom observation for the GE class and both SPED classes. I observed each class for 90 minutes. I recorded detailed notes for each classroom observation. On April 28, 2016, I conducted the second classroom observation for both SPED classes and the GE class. I observed each class for 90 minutes and recorded detailed notes for each classroom observation.

Further, I used the classroom observation instrument to report the behaviors, level of engagement, and interactions between the teachers and students. More specifically, I documented how the teachers interacted with the students and how the students interacted with MobyMax. I recorded notes regarding communication among the teachers and students. Immediately after the classes ended, I used the field notes I recorded to assist the completion of any remaining sections on the classroom observation instrument.

On May 5, 2016, I conducted the follow-up teacher interviews for the GE and SPED teacher participants. I conducted the follow-up teacher interviews after regular school hours in the school conference room. The length of the interviews was about 20 minutes each. On May 6, 2016, I conducted the follow-up student focus group interviews for the SPED and GE student participants. First, I conducted the SPED student focus group interviews before regular school hours in the school conference room for about 15 minutes. Then, I conducted the GE student focus group interviews after regular school hours in the school conference room for about 15 minutes. I interviewed five out of the six GE students (Darrell, Sarah, Griffin, Grace, and Helen) due to transportation issues. Edward experienced transportation issues similar to the day of the introductory focus group interviews. In addition, Helen was only interviewed during the GE follow-up student focus group interview because her parent/guardian consent and student assent forms were received after the introductory GE student focus group interview was conducted. I recorded all interviews using a digital voice recorder. Finally, I collected weekly lesson plans from each teacher participant during the 6-week data collection timeframe.

Only one variation occurred in the data collection process. I was able to collect valuable information from each teacher's lesson plans, such as standards reviewed and how MobyMax was incorporated into daily instruction. However, the variation was in relation to Mr. Beau's lesson plans. Mr. Beau provided the same lesson plan each week, which provided little latitude when constructing the codes for his lesson plans.

Level I Data Analysis

At the first level, I coded and categorized data from each data source. I used line-by-line coding recommended by Charmaz (2006) and constructed codes for the teacher interviews and student focus group interviews. I used Charmaz's method of forming gerunds for coding. The use of action verbs in data codes was invaluable. The method of forming gerunds allowed me to reflect upon the data and to be deliberate in pulling out what actually happened from the data. Further, I analyzed the coded data by using the constant comparative method that Charmaz and Fram (2013) recommended to construct categories.

Next, I used content analysis to examine the classroom observations and teacher lesson plans. In the content analysis, I focused on teacher and student behaviors, level of engagement, and interactions between teachers and students. During the classroom observations, I recorded field notes regarding communication among the teachers and students. Immediately after the classes ended, I reviewed the field notes to assist the completion of any remaining sections on the classroom observation instrument. I decided to assign a color for each of the eight sections of the classroom observation instrument.

Then, I read through the field notes and highlighted each line with the relating color for the section on the classroom observation instrument. I completed this process throughout the field notes. This process allowed me to connect individual codes from the field notes with the corresponding section on the classroom observation instrument. The classroom observations yielded data regarding how computer-assisted instruction is used to differentiate instruction and learning during a year-end instructional unit.

Further, I used content analysis to examine the teacher lesson plans to better understand how the teachers incorporated computer-assisted instruction to achieve differentiated instruction. In the lesson plans provided by both teachers, I found that they used computer-assisted instruction for the purposes of supplementary instruction and assessment. In addition, the teacher lesson plans provided a concrete picture of how computer-assisted instruction was embedded in the year-end review unit to meet the needs of all students. Each lesson plan included instructional planning for an entire week. I collected six lesson plans from each teacher participant.

Finally, I examined all lesson plans provided by each teacher participant. Mrs. Mary and Mr. Beau organized their lesson plans into similar sections. Because the teachers organized the lesson plans into similar and specific sections, this aided the content analysis by revealing the teachers' purpose and plan for each section within the lesson plans. I constructed individual codes based on the plan for teacher and student behaviors, activities promoting student engagement, and the plan for teacher and student interactions within each section of the lesson plans. I grouped repetitive and important codes into categories. Thus, I constructed a summary table of categories for each data source.

Teacher and student interviews

Introductory teacher interview with Mrs. Mary. This section includes the description of Mrs. Mary's introductory teacher interview responses. The first two interview questions addressed Mrs. Mary's number of years teaching experience, grade level, and subject area taught. Mrs. Mary replied that she has taught fourth grade mathematics for 12 years. She has taught at the research site the duration of her career. In addition, Mrs. Mary stated that she has used MobyMax for two and half years at the research site.

When I asked Mrs. Mary to define differentiated instruction, she expressed her belief that differentiated instruction focused on meeting the needs of individual students. She believed that differentiated instruction included recognition of student weaknesses and modifying instruction to help students be successful. Therefore, Mrs. Mary believed differentiated instruction was centered on meeting students' individual needs. Further, I asked Mrs. Mary to define computer-assisted instruction. Mrs. Mary believed that computer-assisted instruction consisted of instruction provided by a computer. Mrs. Mary stated, "The computer does the practice and lessons for the student and really does not require much teacher intervention." Thus, Mrs. Mary believed that computer-assisted instruction was primarily led by the computer and/or program and required little teacher involvement.

Next, I asked Mrs. Mary to explain how her students used MobyMax. Mrs. Mary explained that her students used MobyMax for the same amount of time; however, the skills and lessons were different for individual students. Mrs. Mary maintained that her students did not choose how to use MobyMax. She explained that she used MobyMax as a daily center activity and to practice previously taught skills. She also preferred to introduce and teach skills via teacher-led whole group instruction. Mrs. Mary stated,

> My students did not decide, but I decided how to use MobyMax. I used it daily in a center as a practice method. I didn't really use it as primary instruction. It was more of a practice to reinforce the skills we have already learned or the skills they were weak on.

As a result, Mrs. Mary believed MobyMax was best used to reinforce or practice previously taught skills.

In addition, I asked Mrs. Mary if she felt that she was able to use MobyMax to incorporate individual student interests. Mrs. Mary stated, "The program definitely does very well in the differentiation for their needs but not for their interests. Frankly, because of the specific way it [MobyMax] required the students to answer the questions." Thus, Mrs. Mary believed that MobyMax lacked the capability to address student interests; however, she believed MobyMax did differentiate to meet students' instructional needs. Further, Mrs. Mary believed that not all students successfully answered mathematics questions on MobyMax due to the required method to input answers. She believed

MobyMax lacked the ability for students to demonstrate their understanding in a variety of ways.

I asked Mrs. Mary to speak about MobyMax reports and the data gleaned from the reports. Mrs. Mary explained that she generated reports at the end of each week to monitor student progress. Mrs. Mary stated,

> I pulled MobyMax reports at the end of the week to see whether the students worked on grade level. Specifically, I looked to see whether students were moving up or moving down. I looked to see if there was a specific skill that students needed to repeat.

Therefore, Mrs. Mary believed that MobyMax reports allowed her to monitor students' progress. She also determined whether her students mastered specific skills or needed remediation. Mrs. Mary assigned specific skills for individual students and required students to redo lessons if they did not earn a 70 or above. She believed MobyMax scores were accurate and comparable to scores on paper and pencil worksheets. Mrs. Mary maintained, "The results were definitely very accurate to what I would normally get out of those kids."

She also believed it was imperative to differentiate the MobyMax curriculum to meet individual student needs. I asked Mrs. Mary if she believed the curriculum on MobyMax was closely aligned to the curriculum that she taught or were there some discrepancies. Mrs. Mary believed the MobyMax curriculum aligned closely to the Georgia Mathematics Standards of Excellence. However, the MobyMax program required students to input answers in a specific way. Therefore, Mrs. Mary believed the

MobyMax requirements for inputting answers impeded the ability for some students to be successful.

Mrs. Mary reported several positive aspects of working with MobyMax. Mrs. Mary believed MobyMax was an effective resource to differentiate lessons for individual students. She also believed differentiation was achieved with little teacher intervention. Mrs. Mary stated, “Definitely liked the differentiated instructional practice part of it. It was an easy way to assign students specific practice skills. It did not require much teacher intervention.” Thus, Mrs. Mary valued the differentiated instruction provided by the MobyMax program and appreciated the limited amount of time required for teacher intervention.

Conversely, Mrs. Mary reported one negative aspect of using MobyMax. She believed that MobyMax was a good program overall and expressed that she really liked MobyMax. However, she did reiterate the varying input method required by MobyMax. Mrs. Mary stated,

> The only negative was that MobyMax required the students to fill in each box in a specific way. The students were required to input answers the way MobyMax expected them to be answered. However, I did like those little instructional videos. That did help my students see the way MobyMax expected them to answer questions.

As a result, Mrs. Mary believed that answer input in MobyMax was sometimes challenging for her students. Mrs. Mary expected her students to access the instructional videos whenever needed. In addition, she documented MobyMax as a center activity in her instructional lesson plans. Mrs. Mary also mentioned that she listed MobyMax as a differentiated instruction resource.

Finally, I asked Mrs. Mary to provide recommendations for using MobyMax to remediate student learning and enrichment. Mrs. Mary believed it was imperative to assign specific lessons based on individual student needs. Mrs. Mary also found it beneficial to assign lessons based on fifth-grade standards for her advanced students. Mrs. Mary stated,

> Sometimes I had to change their assigned lessons or go back and make the students redo certain lessons. MobyMax was an easy program to work with. I had changed the level from fourth grade to fifth-grade in MobyMax for my advanced students. So, it was a great way to provide enrichment. I also gave a few students third grade lessons to provide more practice on certain skills. MobyMax was a good program and my kids enjoyed it.

Thus, Mrs. Mary recommended assigning MobyMax lessons based on individual student needs. She believed it was vital to monitor student progress and modify lessons as necessary. Mrs. Mary modified instruction by having struggling students redo lessons. She also assigned fifth-grade standards for advanced students.

Table 2 includes a summary of the major categories that I constructed for Mrs. Mary's introductory teacher interview.

Table 2

Summary of Categories for Mrs. Mary's Introductory Interview

Questions	Categories
TQ1: Years teaching	Teaching twelve years
TQ2: Grade and subject areas	Teaching fourth grade mathematics
TQ3: Years using MobyMax	Employing MobyMax for two and a half years
TQ4: Definition of differentiated instruction	Meeting the needs of all students
	Recognizing student strengths and weaknesses
TQ5: Definition of computer assisted instruction	Relying primarily on the computer program to provide instruction
	Requiring little teacher intervention
TQ6: Student use of MobyMax	Reviewing weak skills
	Using MobyMax in daily centers or early finisher activity
TQ7: Deciding how to use MobyMax	Emphasizing teacher choice for MobyMax classroom implementation
	Modifying skills and lessons for individual students
	Preferring whole group teacher-led instruction for new skills
TQ8: Incorporating student interests	Lacking capability to address student interests
	Lacking capability for students to demonstrate understanding in multiple ways

Questions	Categories
TQ9: Deriving data from MobyMax	Reviewing MobyMax reports most weeks
TQ10: Using data derived from MobyMax	Determining mastery of specific skills
	Assigning specific MobyMax lessons based on student progress
TQ11: MobyMax aligned to Georgia mathematics curriculum	Aligning closely to Georgia mathematics standards (MobyMax curriculum)
TQ12: Positive aspect of MobyMax	Requiring little teacher intervention
	Assigning specific skills for students
	Differentiating instruction
	Monitoring student progress
TQ13: Negative aspects of using MobyMax	Requiring students to input answers in a specific way (MobyMax)
TQ14: Documenting MobyMax in lesson plans	Listing MobyMax under centers section
TQ15: Recommendations for using MobyMax	Monitoring student progress
	Assigning new lessons as needed
	Changing grade levels of lessons as needed (up or down)
	Repeating lessons for struggling students

Follow-up teacher interview with Mrs. Mary. This section includes the description of Mrs. Mary's follow-up interview responses. To start, I asked Mrs. Mary to elaborate about how the GE students used MobyMax during the year-end review unit.

Mrs. Mary explained that the time allowed for MobyMax was flexible because early finishers were given the remainder of class time to work with MobyMax. This was true for days when centers were not planned. Mrs. Mary stated,

> I decided how to use MobyMax based on the MobyMax placement test. The amount of time was based on the time I had that day for that particular center. If it was a day that I wasn't doing centers, then the students had the remainder of the period to work with MobyMax after they finished my work.

Thus, Mrs. Mary made decisions regarding individual student lessons based on the MobyMax placement test data. In addition, she adapted students' MobyMax use based on their completion of the daily assignments.

Next, I prompted Mrs. Mary to expound on how she used MobyMax to meet the individual needs of all students during the year-end review unit. Mrs. Mary stated,

> Definite remediation, MobyMax basically remediated the students itself. MobyMax differentiated to the students a lot better than I could. MobyMax assigned students specific skills rather than having a group of students who I might have met one or two of those skills. I just think MobyMax did a better job, it was more specific.

Therefore, Mrs. Mary believed MobyMax was an effective program for remediating weak skills and differentiating instruction for individual students. She also believed that MobyMax was able to differentiate more effectively than she could.

In addition, I asked Mrs. Mary to state whether she was able to use MobyMax to incorporate individual student interests during the year-end review unit. Mrs. Mary believed that MobyMax met individual students' academic needs but not necessarily their interests. Mrs. Mary stated,

> Interests, no, but definitely their needs of what they needed to learn, yes. I wouldn't say that every kid was interested in MobyMax. MobyMax was really just one modality. So, I wouldn't think it would be geared to one particular child's interests.

Thus, Mrs. Mary believed MobyMax differentiated for students' instructional needs but lacked the capability to address student interests. Mrs. Mary also reported several positive aspects to using MobyMax during the year-end review unit. She believed that MobyMax was effective at providing remedial instruction for her students. Mrs. Mary stated,

> If I wanted to go along with the program based on their placement test scores, there was absolutely nothing that I had to do. Now of course, I went in and made some changes just based on what I saw a kid was having some issues with that might not have shown up on that test. But it was a great program.

Mrs. Mary believed the MobyMax program was an effective means of providing remediation for struggling students. However, she did express the importance of monitoring student progress and adjusting MobyMax lessons based on student needs.

Conversely, I asked Mrs. Mary to reveal any issues she encountered when implementing MobyMax during the year-end review unit. She reported no issues during implementation. Mrs. Mary believed the implementation of MobyMax during the year-end review unit went well, and MobyMax was an effective method for reviewing for the Georgia Milestones Assessment.

Further, I inquired whether Mrs. Mary felt it was worth her time and effort to implement MobyMax into the year-end review unit. Mrs. Mary stated, “Yes, I had to change some of the skills, not as a fault of MobyMax, just because it was something I wanted the kids to practice more.” Thus, Mrs. Mary believed it was worth her time and effort to implement MobyMax during the year-end review unit. She modified MobyMax lessons for individual students as needed. Mrs. Mary documented MobyMax as a center activity or an extension activity for early finishers in her lesson plans.

Next, I asked Mrs. Mary to state her recommendations for using MobyMax to remediate and enrich student learning during the year-end review unit. Mrs. Mary stated,

> Next year, I will do the placement test more frequently so that it targets more skills. I definitely will do it [MobyMax placement test] every week next year to make sure those skills are very specific to that kid. Any teacher that used MobyMax would need to go in and manually set more enrichment type things, especially after the Milestones [Georgia Milestones Assessment].

Mrs. Mary continued to explain that MobyMax did not automatically assign students advanced content, such as fifth-grade standards, based on their progress within the MobyMax program. All GE and SPED student participants completed the fourth grade Georgia Milestones Assessment during the fourth week of the six week data collection timeframe for this study. Mrs. Mary felt some of her students were ready to be exposed to the fifth-grade standards. Therefore, Mrs. Mary decided to manually assign the advanced standards within MobyMax for Griffin, Grace, and Helen during the last two weeks of the data collection timeframe. As a result, Mrs. Mary believed teachers should assign the placement test more frequently to obtain a true reading of student progress. She believed teachers should assign specific lessons for individual students based on their needs and cognitive ability.

Finally, I asked Mrs. Mary to share any thoughts or comments she had in regards to student behaviors and engagement while using MobyMax during the year-end review unit. Mrs. Mary stated, “I felt like the students became more engaged the more that they used it [MobyMax].” Mrs. Mary also described how she customized MobyMax settings that controlled the rate at which students earned MobyMax game time. Mrs. Mary believed a higher rate of exposure and practice with MobyMax increased student achievement. She also believed the students’ ability to earn MobyMax game time based on the number of correct responses they input also increased their level of engagement. Thus, Mrs. Mary believed MobyMax game time promoted excitement toward MobyMax and the mathematics lessons.

Table 3 includes a summary of the major categories that I constructed for Mrs. Mary’s follow-up teacher interview.

Table 3

Summary of Categories for Mrs. Mary's Follow-up Interview

Questions	Categories
TQ1: Students using MobyMax during year-end review	Emphasizing MobyMax time was flexible
TQ2: Deciding how to use MobyMax during year-end review	Providing remedial and advanced instruction
	Employing MobyMax as center activity
	Employing MobyMax as early finisher activity
	Assigning lessons based on MobyMax placement test
TQ3: Using MobyMax to meet individual needs during year-end review	Providing remedial and advanced instruction
	Monitoring student progress
	Differentiating instruction
TQ4: Incorporating student interests during year-end review	Lacking capability to address student interests
TQ5: Positive aspect of using MobyMax during year-end review	Requiring little teacher intervention
	Monitoring student progress
	Providing remedial and advanced instruction
	Assigning specific lessons for individual students
TQ6: Encountering issues when implementing MobyMax during year-end review	Reporting no issues

Questions	Categories
TQ7: Feeling that it was worth the time and effort to implement MobyMax during year-end review	Emphasizing overall satisfaction
TQ8: Documenting MobyMax in lesson plans during year-end review	Listing MobyMax as center activity
	Listing MobyMax as extension activity
TQ9: Recommendations for using MobyMax during year-end review	Monitoring student progress closely
	Assigning placement test more often
	Assigning specific lessons for individual students
TQ10: Student behaviors and engagement while using MobyMax during year-end review	Correlating a higher rate of MobyMax exposure and practice to increased student engagement
	Correlating a higher rate of MobyMax exposure and practice to increased excitement towards mathematics
	Earning MobyMax game time increases students engagement

Introductory teacher interview with Mr. Beau. This section includes the description of Mr. Beau's introductory interview responses. The first two interview questions addressed Mr. Beau's number of years teaching experience, grade level, and subject area taught. Mr. Beau stated that he taught fourth grade mathematics for four years. He has taught one of the four years at the research site. Additionally, Mr. Beau stated that he used MobyMax for one year. The cooperating school district has implemented the MobyMax program for the past three years.

When I asked Mr. Beau to define differentiated instruction, he maintained that differentiated instruction allowed him to meet individual student needs and satisfy different learning styles. Mr. Beau explained the need for a SPED teacher to differentiate instruction each day due to the host of developmental levels, interests, and needs within a SPED classroom. Thus, Mr. Beau believed differentiated instruction was a way to meet the needs of all students. Next, I asked Mr. Beau to define computer-assisted instruction. Mr. Beau expressed the viewpoint that computer-assisted instruction was a supplementary resource used to remediate student learning and allowed for small group instruction. He stated,

> It was a supplementary program to what I taught. It was a way for me to break students into smaller groups. The computer occupied two or three students at a time while I worked with two or three students at a time or while some others were doing independent work.

As a result, Mr. Beau believed MobyMax aided the ability to differentiate instruction by supplementing and modifying instruction for more individualized student support.

In addition, I asked Mr. Beau how his SPED students used MobyMax. He explained that his students used MobyMax for different amounts of time. He noted that his classes were comprised of different learning levels; therefore, he modified the lessons and time based on student ability. Mr. Beau noted that he modified MobyMax lessons where students received a level of instruction they were capable of doing. Therefore, Mr. Beau used MobyMax to meet or pair students' capabilities with different levels of the MobyMax program.

When I prompted Mr. Beau to expound on how he and/or the SPED students decided to use MobyMax, he explained that MobyMax was used for early finishers and as a supplementary instructional resource. He believed MobyMax allowed for small group instruction. Mr. Beau stated, "We usually used it [MobyMax] if we finished a task early or if we were ahead of schedule and sometimes we used it supplementary." He explained that he used MobyMax to break things down so he did not solely implement whole group instruction. Thus, Mr. Beau used MobyMax to supplement and modify instruction and to differentiate student work.

Further, Mr. Beau believed MobyMax met individual student interests because most SPED students enjoyed working on the computers. Mr. Beau stated,

> Most of them liked to be on the computer. They thought that was a privilege, so it motivated them to earn MobyMax time. They thought they completed something on their own and that achievement made them feel good.

Therefore, Mr. Beau believed MobyMax incorporated individual interests, promoted student enjoyment of working on computers, and allowed students to experience achievement.

Next, I asked Mr. Beau to speak about MobyMax reports and the data gleaned from the reports. Mr. Beau explained that he was able to identify weak skills as well as the areas students were doing well. Mr. Beau believed MobyMax reports were quality sources that he used to monitor student progress. He accessed the reports about three times throughout the year. In addition, Mr. Beau believed MobyMax worked well for reviewing previous skills. Mr. Beau noted, "I looked at the reports to see how everybody as a whole was struggling and what we needed to work on." Therefore, Mr. Beau believed MobyMax produced quality reports that aided his ability to monitor student progress.

I asked Mr. Beau if he believed that the MobyMax curriculum was closely aligned to the curriculum that he taught or were there some discrepancies. Mr. Beau stated, "There were a few discrepancies, but only because I taught students that were below grade level." Thus, Mr. Beau believed there were few discrepancies between the MobyMax curriculum and the fourth grade mathematics Georgia Standards of Excellence. In addition, Mr. Beau elaborated on several positive features and outcomes of MobyMax. He believed that students were more engaged and put forth more effort when they worked with MobyMax as opposed to a paper worksheet. Mr. Beau stated,

> MobyMax had a lot of great features like fact fluency, lessons based on individual skills, and test preparation. I found that students were more likely to put forth effort if they worked with MobyMax instead of worksheets. They got excited when they worked with MobyMax.

As a result, Mr. Beau believed MobyMax aided multiplication and division fact mastery for students. He also believed MobyMax lessons promoted a higher level of student engagement and excitement towards mathematics than individual worksheets.

When asked about the negative aspects of MobyMax, Mr. Beau reported limited MobyMax time due to the large number of fourth grade mathematics standards. Mr. Beau stated, "No real negatives, just sometimes we didn't have time to get to it [MobyMax] because we had so much to teach." Therefore, Mr. Beau believed there was limited time to implement MobyMax because he primarily used the program to supplement instruction. He introduced and taught the standards via teacher-led instruction. Mr. Beau explained the MobyMax program was an instructional technology resource that he used for small group remediation and enrichment.

Finally, I asked Mr. Beau to state his recommendations for using MobyMax to remediate student learning and enrichment. Mr. Beau recommended using MobyMax to identify weak skills and to provide repetition of those skills until students become proficient. Lastly, he explained that he provided worksheets to challenge students that needed enrichment.

Table 4 includes a summary of the major categories that I constructed for Mr. Beau's introductory teacher interview.

Table 4

Summary of Categories for Mr. Beau's Introductory Interview

Questions	Categories
TQ1: Years teaching	Teaching four years
	Teaching at research site for one year
TQ2: Grade and subject areas	Teaching fourth-grade mathematics
TQ3: Years using MobyMax	Using MobyMax one year
TQ4: Definition of differentiated instruction	Meeting the needs of all students
	Varying instructional methods
TQ5: Definition of computer-assisted instruction	Individualizing student support

Questions	Categories
TQ6: Student MobyMax use	Varying students' time with MobyMax
	Pairing students' capabilities with different levels of MobyMax
TQ7: Deciding how to use MobyMax	Supplementing primary instruction
	Differentiating student lessons
TQ8: Incorporating student interests	Identifying MobyMax as fun
	Enjoying time on computers
TQ9: Using data derived from MobyMax	Monitoring student progress
TQ10: Using data derived from MobyMax	Supporting student learning
TQ11: MobyMax aligned to Georgia mathematics curriculum	Reporting few discrepancies
TQ12: Positive aspects of MobyMax	Supporting special education student's needs
	Engaging students via MobyMax game time
	Engaging students via instructional videos
TQ13: Negative aspects of MobyMax	Explaining limited time for MobyMax
TQ14: Documenting MobyMax in lesson plans	Listing MobyMax as technology activity
TQ15: Recommendations for using MobyMax	Customizing MobyMax curriculum
	Using MobyMax game time as incentive
	Challenging students above grade level

Follow-up teacher interview with Mr. Beau. This section includes the description of Mr. Beau's follow-up interview responses. First, I asked Mr. Beau to elaborate about how the SPED students used MobyMax during the year-end review unit. He reported that all of his students were allowed some time to use MobyMax during the year-end review. However, his students did not all work with MobyMax for the same amount of time. Mr. Beau believed that teaching basic math facts via MobyMax was not the most effective method. He affirmed that he could teach the basic math facts better than MobyMax. Therefore, Mr. Beau differentiated the amount of MobyMax time for students based on individual needs.

When I asked Mr. Beau to expound on how he and/or the students decided to use MobyMax during the year-end review unit, he maintained that he utilized the MobyMax program to reduce group sizes. Mr. Beau noted, "When planning the review unit, I decided to make even smaller groups for the ones that needed pre-requisite skills." As a result, Mr. Beau believed MobyMax was beneficial for preparing and reviewing for the Georgia Milestones Assessment. Notably, Mr. Beau expressed satisfaction with the self-paced component of MobyMax. Mr. Beau explained, "I used MobyMax to remediate and review previous lesson material. I believe it worked as a good tool to provide individual learning practice at a pace that each student was comfortable or needed." Hence, Mr. Beau believed that MobyMax was successful in meeting individual student needs.

In addition, I asked Mr. Beau to state whether he was able to use MobyMax to incorporate individual student interests during the year-end review unit. He explained that his students enjoyed working on MobyMax and earning game time. Mr. Beau believed his students' confidence and accuracy in mathematics increased while using MobyMax during the year-end review unit. Further, Mr. Beau reported several positive aspects of using MobyMax during the year-end review unit. Mr. Beau described his satisfaction with using MobyMax to review and prepare for the Georgia Milestones Assessment. He also noted that he divided students into smaller groups when employing MobyMax during the year-end review unit. He believed that small group instruction was a pedagogically appropriate approach to meeting individual student needs.

Conversely, I asked Mr. Beau to reveal any issues he encountered when implementing MobyMax during the year-end review unit. Mr. Beau reported no issues with implementing MobyMax into his classroom instruction. He also stated that he usually incorporated technology into each instructional unit. Therefore, Mr. Beau believed MobyMax was a beneficial source of computer-assisted instruction for his students during the year-end review unit.

When I inquired whether Mr. Beau felt it was worth his time and effort to implement MobyMax into the year-end review unit, he maintained that it was worth the time and effort to implement MobyMax. He also explained that MobyMax was used to review the fourth grade mathematics standards and a way for the students to become more familiar with utilizing Chromebooks. He believed the students needed to review beginning of the year lessons. Thus, Mr. Beau believed that MobyMax was worthwhile for reviewing the fourth grade mathematics standards during the year-end review unit. He reported that he listed the MobyMax program under the technology section of his lesson plans.

Next, I asked Mr. Beau to state his recommendations for using MobyMax to remediate and enrich student learning during the year-end review unit. Mr. Beau expressed the importance of assigning MobyMax lessons to build student confidence and then increasing the rigor of lessons as the students progressed. Mr. Beau stated,

> I think you [researcher] was here the day that I did some mental math using MobyMax. I tried to get the students to not use any scratch paper when practicing mental math. I wanted to try to get the students to do these skills in their head to make it a little bit more difficult.

Thus, Mr. Beau recommended that students should begin with lower level MobyMax lessons in order to build confidence. The teacher should increase the rigor of MobyMax lessons as the students progress.

Finally, I asked Mr. Beau to share any thoughts or comments he had in regards to student behaviors and engagement while using MobyMax during the year-end review unit. Mr. Beau stated that MobyMax reduced behavior issues due to allowing for small group instruction. He also noted the use of MobyMax to remediate student learning and enrichment. Lastly, he expressed satisfaction with his ability to track and monitor student progress via MobyMax reports. Mr. Beau explained,

> You can get the group small enough where behavior is really not an issue. MobyMax is a great tool for remediation and engaging student learning. Students navigated the program pretty easily which provided the time to work with a smaller group. However, others worked independently on math skills. MobyMax is also great for data collection and progress monitoring.

As a result, Mr. Beau believed the computer-assisted instruction program, MobyMax, increased student engagement and reduced behavior issues.

Table 5 includes a summary of the major categories that I constructed for Mr. Beau's follow-up teacher interview.

Table 5

Summary of Categories for Mr. Beau's Follow-up Interview

Questions	Categories
TQ1: Students using MobyMax during year-end review	Reducing student group size for year-end review
TQ2: Deciding how to use MobyMax during year-end review	Utilizing MobyMax to prepare for Georgia Milestones Assessment
TQ3: Using MobyMax to meet individual needs during year-end review	Remediating student learning
	Allowing self-paced learning for students (MobyMax)
	Promoting individual practice
	Increasing student confidence in math skills
	Meeting individual student needs
TQ4: Incorporating student interests during year-end review	Perceiving that students' interests met with MobyMax
TQ5: Positive aspect of using MobyMax during year-end review	Increasing student confidence in math skills
	Increasing student accuracy of math skills
	Implementing small groups for year-end review

Questions	Categories
TQ6: Encountering issues when implementing MobyMax during year-end review lesson plans	Reporting no issues
TQ7: Feeling that it was worth the time and effort to implement MobyMax during year-end review	Reviewing curriculum Practicing with Chromebooks
TQ8: Documenting MobyMax in lesson plans during year-end review	Listing MobyMax in the technology section
TQ9: Recommendations for using MobyMax during year-end review	Increasing rigor of lessons as needed Assigning lessons based on student needs Reducing group size for year-end review Reducing behavior issues Earning MobyMax game time increases students engagement
TQ10: Student behaviors and engagement while using MobyMax during year-end review	Correlating a higher rate of MobyMax exposure and practice to increased student engagement Correlating a higher rate of MobyMax exposure and practice to increased excitement towards mathematics

General education introductory student focus group interview. The first two interview questions addressed the GE students' number of years experience using MobyMax and how many times per week the students used MobyMax. The students reported a range of two to four years of experience with the MobyMax program. In addition, the students reported a range of weekly use with MobyMax. Students reported MobyMax use at school and at home. Darrell stated that he used MobyMax five days per week. Sarah commented, “Seven”. I clarified her answer and asked, “Seven days per week, so does that mean you use it at home too?” She stated, “Yes.” Griffin added, “Seven days per week. I use it on my phone.” Finally, Grace stated, “five days per week.” Therefore, students reported a range of five to seven days of weekly use with MobyMax. Students also reported using MobyMax at school, home, and via personal smart phone.

Next, I asked the GE student participants if they would like to use MobyMax more or less than the amount of time they used it in class. Darrell, Sarah, Griffin, and Grace stated, “More.” In addition, the students believed MobyMax helped them better understand fourth grade mathematics. The students also unanimously reported that MobyMax was fun. Next, I inquired whether all of the GE student participants used MobyMax for the same amount of time and in the same way. Students responded that all students used MobyMax for the same amount of time and in the same way. Darrell elaborated, “We worked in groups and each group worked on it at a different time. We all had the same amount of time to work in each group.” Griffin explained, “Mostly we took turns doing it in different groups. Because we each were in a group and when our group got to that station, we did it [MobyMax] and then we moved on to another station when we finished.” Therefore, the GE student participants believed they primarily used MobyMax in small groups while rotating centers.

Further, I prompted the GE students to expound on what their teacher did while they were working on MobyMax. Students reported limited choice on how they used

MobyMax. The students explained that Mrs. Mary told them how to work with MobyMax. In addition, the students maintained that Mrs. Mary did not stop to talk to them very often while working with MobyMax. However, Griffin elaborated, "If we needed help, we raised our hands and she went to us and helped us."

The GE students reported specific parts of MobyMax that they did enjoy. Students reported that they enjoyed the ability to take their time when answering questions in MobyMax. The students also reported that MobyMax was fun. Griffin explained,

> I liked the way it [MobyMax] gave you enough time to answer the questions and it didn't limit you. I liked when you got a good grade on it [MobyMax] did something really funny with animals. The animals did like tricks and stuff.

The GE students enjoyed solving MobyMax problems. Lastly, the students enjoyed the animal animations that displayed after submitting a correct answer.

Conversely, the GE student participants reported specific parts of MobyMax that they did not enjoy. Sarah stated, "Sometimes I did not like it [MobyMax] because it did it in different ways than the way we learned it. I just didn't understand it." Sarah's response described the answer input methods required by the MobyMax program. The students reported confusion in regards to submitting answers for certain MobyMax multiplication problems. Therefore, students believed some of the MobyMax instructional approaches were different than the instructional approaches of their teacher. Finally, I asked the GE students to share some ways that Mrs. Mary could have better used MobyMax. The students expressed their desire to work with MobyMax more often. The students also recommended that Mrs. Mary should adjust the level of difficulty of MobyMax lessons to meet their individual needs.

Table 6 includes a summary of the major categories that I constructed for the GE introductory focus group interview.

Table 6

Summary of Categories for GE Introductory Student Focus Group Interview

Questions	Categories
SQ1: Years using MobyMax/Times per week	Ranging two to three years experience
	Ranging five to seven days per week
SQ2: Using MobyMax more or less	Wanting to use MobyMax more
SQ3: Students using MobyMax	Using MobyMax at school and home
	Using MobyMax via personal smart phone
SQ4: Deciding how to use MobyMax	Using MobyMax is fun
	Using MobyMax in small groups
	Rotating center stations
SQ5: Communicating while using MobyMax	Interacting with students very little during MobyMax time (Mrs. Mary)
	Providing assistance if students raise their hands
SQ6: Positive aspects of MobyMax	Enjoying animal animations
	Emphasizing enjoyment of solving mathematics problems via MobyMax

Questions	Categories
SQ7: Negative aspects of MobyMax	Confusing how to input certain multiplication answers in MobyMax
SQ8: Improving use of MobyMax	Expressing desire to work with MobyMax more often Recommending for the teacher to adjust level of difficulty for individual students

General education follow-up student focus group interview. The first two interview questions inquired about the GE students' use of MobyMax during the year-end review unit. The students unanimously stated the teacher decided how students used MobyMax during the year-end review unit. The students explained that Mrs. Mary assigned MobyMax as a center activity and divided the class into small groups. The small groups rotated through the centers at Mrs. Mary's direction. Griffin elaborated, "The teacher [Mrs. Mary] lets us go in different groups and we got a separate amount of time." Therefore, the students believed they had little or no choice in deciding how to use MobyMax. In addition, students reported unanimously that they wanted to use MobyMax more often because MobyMax explained the mathematics problems in a manner they could understand. Griffin stated,

> I would like to play more on it [MobyMax] because it is fun. When you get like an 85 and above, it will make something funny like a panda bear doing flips or a penguin doing a waddle or something like that.

Helen explained, “More, because it taught us and it was actually pretty fun. It just made you feel good when you got right answers.” Therefore, the students believed the MobyMax program explained mathematics problems in a manner that was easy for them to understand. The students also described features of MobyMax that allowed them to feel successful and excited about submitting correct answers.

Next, I prompted the GE students to expound on what their teacher did while they worked with MobyMax during the year-end review unit. The students reported that Mrs. Mary interacted with them very little while they worked with MobyMax during the year-end review unit. Griffin described how Mrs. Mary monitored the computers and Chromebooks to see what the students were working on. He also stated that if the students needed help, Mrs. Mary would go over to the student and provide assistance.

In addition, I asked the GE students to report specific parts of MobyMax that they enjoyed during the year-end review unit. The students stated that they enjoyed working with MobyMax. Griffin added, “I liked the math because when you got an answer wrong, it [MobyMax] will show you what you did wrong, and there was a little spot up there that taught us how to do it so next time we could get it right.” In the previous response, Griffin described the icon for the MobyMax tutorials. Conversely, I asked the GE students to report specific parts of MobyMax that they did not enjoy during the year-end review unit. Students took issue with the number of questions in the MobyMax lessons. Students also mentioned misunderstanding the alternate ways that MobyMax presents problems. Sarah noted, “I didn’t like it because sometimes it explained it in a different way than the teacher [Mrs. Mary] and I got it wrong because I didn’t know how to do it that way." Therefore, students confused the methods taught by Mrs. Mary as compared to MobyMax methods.

Further, I asked the GE students to share some ways Mrs. Mary could improve the way she used MobyMax to teach the year-end review unit. Darrell stated, "She could have given us more time." Griffin added,

> I think that she should give us more time. But if you ask us to do a specific grade, like a good grade and we don't do it, then she will give us more time to get that specific grade that she wanted.

In the previous response, Griffin described how Mrs. Mary required students to repeat lessons where the student scored below a 70. Helen proposed,

> More time because sometimes the problems will take us too long and she will be like time up. We need more time for the long problems but she [Mrs. Mary] only gives us a specific amount of time.

Therefore, the students wanted more time to work with MobyMax. Mrs. Mary assigned 12 minutes for each center rotation. However, students believed they needed more time to work in the MobyMax center because some of the MobyMax questions required more time to solve than others.

Finally, I asked the GE students to share any other thoughts or comments they might have in regards to using MobyMax during the year-end review unit. The students reported overall enjoyment with the MobyMax program. Sarah stated, "If you get it [the answer] wrong, it [MobyMax] will tell you the right answer. It [MobyMax] gives you a half of a star. I don't think you should get any points because you got it [the answer] wrong." Helen explained, "I agree with Sarah. They [MobyMax] shouldn't give us any points because we are just plopping it down [answers] even though we don't know it." Therefore, students expressed confusion and dislike concerning the way MobyMax provides partial credit for submitting correct answers after students have already submitted an incorrect answer.

Table 7 includes a summary of the major categories that I constructed for the GE follow-up focus group interview.

Table 7

Summary of Categories for GE Follow-up Student Focus Group Interview

Questions	Categories
SQ1: Deciding how to use MobyMax	Limiting student choice on how to use MobyMax (Mrs. Mary)
	Rotating small groups through centers
SQ2: Using MobyMax more or less	Wanting to use MobyMax more
	Using MobyMax is fun
SQ3: Communicating while using MobyMax	Interacting with students very little during MobyMax time (Mrs. Mary)
	Monitoring computers while students work with MobyMax (Mrs. Mary)
SQ4: Positive aspects of MobyMax	Explaining problems in a manner that is easy for students to understand (MobyMax)

Questions	Categories
	Entering answers in MobyMax is exciting
	Watching animal animations after entering a correct answer
SQ5: Negative aspects of MobyMax	Confusing how to input certain multiplication answers in MobyMax
SQ6: Improving the use of MobyMax	Requesting more time to work in the MobyMax center
SQ7: Sharing comments regarding use of MobyMax	Expressing confusion and dislike for the way MobyMax provides partial credit for incorrect answers
	Expressing the desire to be given more MobyMax game time

Special education introductory student focus group interview. This section includes the description of the SPED introductory student focus group interview responses. The first two interview questions addressed the SPED students' number of years experience using MobyMax and how many times per week the students used MobyMax. The students reported a range of one to three years of experience with the MobyMax program. Additionally, the students reported a range of two to four days per week of use with MobyMax. Moreover, John, Bridgette, and Diane reported wanting to use the MobyMax program less than the amount of time they were using it. John, Bridgette, and Diane justified their answer by reporting their belief that MobyMax was difficult. In contrast, Luke mentioned that he would like to use MobyMax more often.

Luke also noted, “It’s easy and not difficult.” Therefore, the SPED students predominantly reported the desire to use MobyMax less.

Next, I inquired whether all of the SPED student participants used MobyMax for the same amount of time and in the same way. Collectively, the students believed they were given an initial choice of what MobyMax feature they would like to work on (fact fluency, numbers, math, or test prep), but they were expected to continue working on that particular feature of MobyMax. I prompted the students to expound on how often Mr. Beau stopped to talk to them while they worked with MobyMax. The students reported an array of answers for this particular question. Luke stated, “Barely.” Diane stated, “We can stop and ask him questions.” Bridgette noted, “A lot.” John added, “Not at all.” Therefore, the students varied in their perceptions of teacher communication and interaction while they worked with MobyMax.

Further, I asked the SPED students to report specific parts of MobyMax that they did enjoy. John, Bridgette, Diane, and Luke all agreed that they enjoyed practicing multiplication facts via MobyMax. Conversely, I asked the students to report any specific parts of MobyMax that they did not enjoy. The students believed MobyMax was sometimes confusing and boring. The students explained that sometimes they were confused on how to submit answers when solving MobyMax problems, specifically multiplication. Finally, I asked the students to report some ways Mr. Beau could improve the way he used MobyMax. Diane and Luke requested for MobyMax to include more games. However, John and Bridgette had no response to this question.

Table 8 includes a summary of the major categories that I constructed for the SPED introductory focus group interview.

Table 8

Summary of Categories for SPED Introductory Student Focus Group Interview

Questions	Categories
SQ1: Years using MobyMax/Times per week	Ranging from one to three years experience
SQ2: Using MobyMax more or less	Wanting to use MobyMax less (John, Bridgette, and Diane)
	Wanting to use MobyMax more (Luke)
SQ3: Students using MobyMax	Using MobyMax is difficult (John, Bridgette, and Diane)
	Using MobyMax is easy (Luke)
	Using MobyMax for different amounts of time
SQ4: Deciding how to use MobyMax	Allowing student choice of MobyMax feature
SQ5: Communicating while using MobyMax	Varying perceptions of teacher communication and interaction with students while working with MobyMax
	Providing assistance if students ask questions
SQ6: Positive aspects of MobyMax	Enjoying MobyMax game time
SQ7: Negative aspects of MobyMax	MobyMax's instructional approaches are sometimes different from the teacher's
SQ8: Improving use of MobyMax	Expressing desire for more MobyMax games (Diane and Luke)

Special education follow-up student focus group interview. This section includes the description of the SPED follow-up student focus group interview responses. The first two interview questions inquired about the SPED students' use of MobyMax during the year-end review unit. The students reported that Mr. Beau made the decision of how MobyMax would be used. Further, the introductory interview yielded three responses desiring less time working with MobyMax and one response requesting more time for working with MobyMax. For this follow-up interview, John stated, "Less, because it takes a long time to do it." However, Bridgette, Diane, and Luke stated, "More." Luke justified by stating, "Because it [MobyMax] has funny pictures and videos and it's very easy." In summation, two out of the three students that reported wanting less time on MobyMax when asked during the introductory interview now reported that they wanted more time to work with MobyMax when asked during the follow-up interview.

Next, I asked the SPED students how often Mr. Beau stopped to talk to them while they used MobyMax during the year-end review unit. The student responses varied for this question. John stated, "He did not stop by very much." Bridgette noted, "A lot." Diane added, "He didn't talk to us or nothing because he didn't want us to mess up." Luke stated, "Sometimes, but not a whole lot." Therefore, students reported varying perceptions regarding the level of teacher communication and interaction while working with MobyMax.

In addition, I asked the SPED students to report specific parts of MobyMax that they enjoyed during the year-end review unit. The students collectively reported enjoying the MobyMax games and the lessons they considered to be easy. Luke explained, "The part I liked was when you got to play games and watch cool videos on MobyMax." Therefore, the students believed the MobyMax games and videos were enjoyable. Conversely, I asked the SPED students to report specific parts of MobyMax that they did not enjoy during the year-end review unit. Most of the students suggested that MobyMax was sometimes difficult and they did not like the MobyMax multiplication problems. However, Luke reported a differing opinion. Luke did not find MobyMax to be difficult and did not report any negative aspects of MobyMax.

Further, I asked the SPED students to share some ways Mr. Beau could have used MobyMax better to teach the year-end review unit. The students suggested that Mr. Beau could have decreased the difficulty of the MobyMax lessons. John requested that Mr. Beau make the MobyMax assignments easier. Bridgette explained, "Break down the math skills a little more so we can understand it." Diane did not believe there was anything that Mr. Beau could have done better. Luke stated, "The multiplication. Explain it and the division to help us out." Therefore, the students believed Mr. Beau could have provided more support to assist them with the MobyMax lessons, specifically multiplication and division.

Finally, I asked the SPED students to share any other thoughts or comments that they might have in regards to using MobyMax during the year-end review unit. John stated, "Nothing." Bridgette added, "Multiplication, it was hard." However, she mentioned that she did not know what Mr. Beau could have done differently during the year-end review unit. Diane explained, "The division is hard. He could help us a little bit to get the answer and give us some hints." Luke stated, "It was hard for me; some of them don't even make sense and they are just difficult." In addition, I asked the students if they viewed the MobyMax tutorials when they did not understand a MobyMax lesson. All four SPED students confirmed that they did view the MobyMax tutorials and that they did find them helpful. Lastly, the students suggested that Mr. Beau could have provided further explanation and support while they were working with MobyMax.

Table 9 includes a summary of the major categories that I constructed for the special education follow-up focus group interview.

Table 9

Summary of Categories for SPED Follow-up Student Focus Group Interview

Questions	Categories
SQ1: Deciding how to use MobyMax	Limiting student choice on how to use MobyMax
	Instructing students on how to use MobyMax (Mr. Beau)
	Employing MobyMax in small groups (Mr. Beau)
SQ2: Using MobyMax more or less	Wanting to use MobyMax more (Bridgette, Diane, and Luke)
	Wanting to use MobyMax less (John)
	Using MobyMax is fun
SQ3: Communicating while using MobyMax	Varying student perceptions of teacher interaction while working with MobyMax

Questions	Categories
SQ4: Positive aspects of MobyMax	Watching funny animations and videos (MobyMax)
	Enjoying MobyMax games
	Watching MobyMax tutorials
SQ5: Negative aspects of MobyMax	Disliking MobyMax multiplication problems
SQ6: Improving the use of MobyMax	Requesting more teacher support during MobyMax lessons
SQ7: Sharing comments regarding use of MobyMax	Benefiting from the MobyMax tutorials
	Expressing that some MobyMax lessons are difficult.
	Emphasizing that MobyMax multiplication and division problems are confusing and difficult

Classroom Observations

Mrs. Mary and the general education student classroom observations. The first section of the classroom observation instrument was context/goal setting. Mrs. Mary's primary goal or purpose for the year-end review unit was to prepare her students for the Georgia Milestones Assessment. She utilized the MobyMax program to review previously taught content based on individual student needs. Mrs. Mary focused on standards heavily weighted on the Georgia Milestones Assessment.

In regards to the student assessment section, Mrs. Mary encouraged peer and self assessment among her students. I observed several instances where Mrs. Mary asked

Griffin and Helen to assist other struggling students with MobyMax problems. In addition, Mrs. Mary implemented an “ask three before me” rule in her classroom. Students were allowed to collaborate by seeking assistance from three classmates. If the students still needed help after consulting with three classmates, the students could then confer with Mrs. Mary. Darrell, Sarah, and Edward were working with MobyMax lessons that were automatically assigned based on their MobyMax placement test. However, Mrs. Mary manually assigned specific lessons for Griffin, Grace, and Helen based on their individual needs.

Mrs. Mary continuously monitored the classroom and left her teacher-led station to provide individual assistance to students when necessary. She recognized that Grace was not assigned the correct skills in MobyMax. She told Grace, “I need to check what I have assigned for you because you should not be working on skills that low.” While monitoring the classroom, Mrs. Mary noticed that Darrell and Edward were off task while working at the math cubes center. Mrs. Mary addressed Darrell and Edward’s behavior and redirected them to get back on task. Mrs. Mary rotated the students between four center stations. She believed this allowed her to maximize instructional time by exposing students to varying assignments suited to multiple learning styles and individual needs.

Mrs. Mary maintained a positive and supportive learning environment by engaging students during the year-end review unit. After reprimanding Darrell, he regained focus and engagement. Later on, Mrs. Mary praised Darrell for following directions and celebrated his success when earning an 80 on a MobyMax division lesson.

In regards to the quality curriculum section of the observation instrument, Mrs. Mary focused on the heavily weighted fourth grade mathematics Georgia Standards of Excellence. The majority of the year-end review unit focused on standards within the domain of numbers and operations. Mrs. Mary used MobyMax and teacher-led small group instruction to provide remediation and enrichment based on these standards.

Mrs. Mary demonstrated preparation and response to learner needs by teaching students how to access the MobyMax tutorial feature. I observed all the GE student participants accessing the MobyMax tutorial feature when needed. In addition, Griffin and Helen chose to use paper and pencil to solve MobyMax problems. Darrell, Sarah, Grace, and Edward chose to use the scratchpad feature in MobyMax to solve problems. Darrell, Sarah, Grace, and Edward also utilized the scratchpad feature to underline key words in the MobyMax problems. Mrs. Mary allowed students to choose the method to solving problems they preferred.

Table 10 includes a summary of the major categories that I constructed for the general education student classroom observations.

Table 10

Summary of Categories for Mrs. Mary and GE Student Observations

Observation Instrument	Categories
Context/Goal Setting	Reviewing previously taught content
	Encouraging peer and self assessment (Mrs. Mary)
Student Assessment	Working on different skills based on MobyMax placement test

Observation Instrument	Categories
Attention to Individuals/Building Community	Monitoring student progress (Mrs. Mary)
	Attending to student needs (Mrs. Mary)
	Collaborating with other students (students)
Instructional Practices and Classroom Routines	Rotating students between four centers (Mrs. Mary)
Positive, Supportive Learning Environment	Supporting and encouraging peers (students)
	Celebrating student success with MobyMax
Quality Curriculum	Working on different skills based on MobyMax pre-assessment (students)
Preparation and Response to Learner Needs	Accessing the tutorial feature in MobyMax as needed (students)
	Using scratchpad feature to underline key words in MobyMax (Darryl)
Evidence of Differentiation	Addressing student needs (Mrs. Mary)
	Collaborating with peers (students)
	Varying student grouping (Mrs. Mary)
	Providing individual student support (Mrs. Mary)

Mr. Beau and the special education student classroom observations. The first section of the classroom observation instrument was context/goal setting. Mr. Beau focused the year-end review unit around student preparation for the Georgia Milestones Assessment. In addition, Mr. Beau constantly circulated the room and monitored student progress. Mr. Beau engaged Luke and Diane by asking them to state the steps to solving multiplication problems as he modeled how to solve the problem on the board. Luke and Diane were working on a multiplication worksheet while John and Bridgette were working with MobyMax.

Mr. Beau implemented the same instructional practices and classroom routines during both classroom observations. Mr. Beau divided the class into two small groups. One group worked on a multiplication worksheet while the other group worked with MobyMax on the Chromebooks. One of the SPED student participants, Luke asked, "Why do they get to get on MobyMax"? Diane replied, "You know everyone will get to do it too". Therefore, it was common practice for Mr. Beau to utilize MobyMax as a means to divide his class into small groups.

Mr. Beau maintained a positive and supportive learning environment by moving back and forth between the worksheet group and the MobyMax group. He assisted students as needed. During the classroom observation, Mr. Beau mentioned that he liked to use MobyMax to divide his class into smaller groups. He explained that small group instruction allowed him to provide more support to individual students. During the classroom observation, he also mentioned that the worksheets were usually related to one of the numbers and operations standards. He chose the numbers and operations standards because they were heavily weighted on the Georgia Milestones Assessment.

All four SPED student participants seemed to put forth more effort while working with MobyMax as opposed to working problems on paper. Luke, John, and Bridgette were slouched in their seats and looking around the room when working on the paper worksheet. In addition, Luke sighed out loud while working on the paper worksheet. Diane was mostly quiet and showed little emotion while working on the paper worksheet. However, the SPED student participants' demeanor changed when working with MobyMax. Bridgette and Diane used their fingers to follow along while they were reading MobyMax word problems. The SPED student participants would make noises when they got an answer correct and incorrect. For instance, Luke would say "yes" or "ah man". Lastly, Luke would laugh at animals displayed on the screen while working with MobyMax.

Mr. Beau demonstrated preparation for and response to learner needs by providing assistive technology to students. Mr. Beau provided headphones for John and Bridgette while working with MobyMax. John and Bridgette struggled with reading the MobyMax word problems. Therefore, he provided the headphones and allowed them to use the MobyMax read aloud feature. Lastly, Mr. Beau knelt beside each individual student that was working with MobyMax to ensure they understood what they were doing and to see if they needed help.

Table 11 includes a summary of the major categories that I constructed for the SPED student classroom observations.

Table 11

Summary of Categories for Mr. Beau and SPED Student Observations

Observation Instrument	Categories
Context/Goal Setting	Reviewing previously taught content
Student Assessment	Assigning MobyMax placement test
	Completing assignments based on placement test results (students)
Attention to Individuals/Building Community	Monitoring student progress
	Interacting with students
	Requesting assistance from teacher (students)
	Varying levels of student support
Instructional Practices and Classroom Routines	Dividing the class into two groups
	Working in a worksheet group and MobyMax group (students)
	Providing individual assistance
Positive, Supportive Learning Environment	Celebrating student success (Mr. Beau and students)
	Encouraging student participation (Mr. Beau and students)
	Displaying excitement about working with MobyMax (students)
Quality Curriculum	Generating various lessons based on placement test data (MobyMax program)
Preparation and Response to Learner Needs	Providing assistive technology (Mr. Beau)
	Using headphones and MobyMax read aloud feature (students)

Observation Instrument	Categories
Evidence of Differentiation	Modifying center time based on student needs
	Providing assistive technology
	Varying level of student support
	Utilizing multiple modes of instruction

Lesson Plans

Mrs. Mary's lesson plans. The first section of Mrs. Mary's lesson plans identified the standards and essential questions covered during each week. Mrs. Mary's lesson plans included all fourth grade Georgia Mathematics standards. However, she specifically focused on the number and operations standards. The number and operations standards are heavily weighted on the Georgia Milestones Assessment.

The whole group/small group section of the lesson plans revealed a variety of center activities. She employed MobyMax as one of four center activities. Mrs. Mary cited MobyMax as a means to implement small group instruction. She also planned for student collaboration such as peer tutoring and individualized student support within the small group instruction.

Within the assessments section, Mrs. Mary provided a brief notation that MobyMax data reports would be used to divide students into small groups. She also noted that MobyMax reports would be used to assign specific MobyMax lesson for students as needed. Lastly, Mrs. Mary listed MobyMax and Chromebooks as differentiated instruction and technology resources.

I constructed individual codes based on the plan for teacher and student behaviors, activities promoting student engagement, and plan for teacher and student interactions within each section of the lesson plans. I grouped repetitive and important codes into categories.

Table 12 presents a summary of the categories that I constructed from an analysis of Mrs. Mary's lesson plans.

Table 12

Summary of Categories for Mrs. Mary's Lesson Plans

Lesson Plans	Categories
Standards and Essential Questions	Identifying fourth grade mathematics Georgia Standards
Whole group and small group instruction	Designing center activities
	Implementing small group instruction
	Planning student collaboration
	Varying student support
Assessment	Incorporating peer tutoring
	Monitoring student progress
	Viewing MobyMax data reports
Materials	Using chromebooks and desktop computers

Mr. Beau's lesson plans. The first section of Mr. Beau's lesson plans, standards and essential questions, identified all fourth grade mathematics standards. However, Mr. Beau focused specifically on the number and operations standards which are heavily weighted on the Georgia Milestones Assessment. Notably, Mr. Beau provided lesson plans with very little changes from week to week during the data collection timeframe for this study.

Further, Mr. Beau utilized the same whole group/small group instructional strategies throughout the duration of the data collection timeframe. Mr. Beau's lesson plans noted two small group activities each week. He planned for a small group worksheet center and a small group MobyMax center. Mr. Beau also provided a brief notation stating that he would provide assistive technology to the SPED students as needed. Lastly, he listed MobyMax and Chromebooks under technology usage.

I constructed individual codes based on the plan for teacher and student behaviors, activities promoting student engagement, and plan for teacher and student interactions within each section of the lesson plans. I grouped repetitive and important codes into categories.

Table 13 presents a summary of the categories that I constructed from an analysis of Mr. Beau's lesson plans.

Table 13

Summary of Categories for Mr. Beau's Lesson Plans

Lesson Plans	Categories
Standards and Essential Questions	Identifying fourth grade mathematics Georgia Standards
Whole group and small group instruction	Dividing class into two groups for more individual support
	Identifying MobyMax as technology center
Assessment	Monitoring student progress
	Accessing MobyMax data reports
Materials	Providing assistive technology
	Using Chromebooks

Level II Data Analysis

At the second level, I examined the categorized data across all data sources to determine within-case and across-case themes. I determined the within-case themes by examining the summary categories for each data source within each individual case. I used Charmaz's (2006) constant comparative method to examine the within-case themes in order to construct across-case themes and discrepancies. More specifically, I determined across-case themes by comparing summary categories across all cases. The within-case and across-case themes formed the key findings of this study.

I determined the key findings by reintegrating the themes in a manner to answer the central and related research questions. The themes described below reflect the purpose and research questions of this study. Therefore, the themes reflected the teachers' and students' perceptions of using MobyMax to differentiate instruction. Lastly, the themes reflected the similarities and differences of how the GE teacher and SPED teacher used MobyMax to differentiate instruction within a fourth grade mathematics classroom.

Within-Case Themes

Through examination of all data sources, the following themes and discrepancies emerged for Mrs. Mary and the GE students: *student needs, small group instruction, and more MobyMax time.*

Student needs. Mrs. Mary believed MobyMax addressed individual student needs. She was able to provide remediation and enrichment for students as needed. Mrs. Mary chose to manually assign specific MobyMax lessons for students. She expressed the importance for teachers to assign the MobyMax placement test regularly in order to obtain a true understanding of student progress. Mrs. Mary believed that MobyMax reports allowed her to monitor student progress to determine whether GE students were mastering specific skills or in need of remediation. Lastly, Mrs. Mary believed her students' MobyMax scores were accurate and comparable to scores on paper and pencil worksheets.

Small group instruction. Mrs. Mary valued the use of MobyMax during small group instruction. She believed MobyMax assisted her primary teacher-led instruction by allowing for individualized student support and reducing behavior issues. She implemented MobyMax as one of four daily center rotations. She believed MobyMax required little teacher intervention. However, she did provide individual assistance for students working with MobyMax as needed.

More MobyMax time. Mrs. Mary and the GE students believed the MobyMax games were fun and promoted excitement towards learning mathematics. She believed MobyMax increased student engagement by earning MobyMax game time based on questions answered correctly. She valued MobyMax game time as a positive incentive to encourage students to put forth effort and focus while working with MobyMax. She believed that students might be likely to submit answers without trying if it were not for a positive incentive like MobyMax game time. She allowed students to use their MobyMax game time at her discretion.

Through examination of all data sources, the following themes and discrepancies emerged for Mr. Beau and the SPED students: *student needs, small group instruction, and more MobyMax time*.

Student needs. Mr. Beau also believed that MobyMax was successful in meeting individual student needs. Mr. Beau and the SPED students believed MobyMax was fun and a great way to learn mathematics. He believed MobyMax aided in monitoring student progress. He believed MobyMax allowed him to focus attention on specific students and provide individual assistance as needed. Mr. Beau noted, “Well see, like now it is right before Georgia Milestones Assessment. We are reviewing, so I can look at the report and see how everybody is struggling and what we can work on.” However, Mr. Beau chose to allow MobyMax to automatically assign specific MobyMax lessons for students.

Small group instruction. Mr. Beau believed MobyMax aided his ability to implement small group instruction during the year-end review unit. Mr. Beau explained,

> You can get the group small enough where behavior is really not an issue. MobyMax is a great tool for remediation and engaging student learning. Students navigated the program pretty easily which provided the time to work with a smaller group.

Mr. Beau incorporated MobyMax into small group instruction by dividing the class into a worksheet group and MobyMax group. He believed MobyMax assisted his primary teacher-led instruction and allow him to provide more individualized support for his SPED students.

More MobyMax time. Mr. Beau and the SPED students believed the MobyMax games were fun and promoted excitement towards learning mathematics. He also believed MobyMax increased student engagement by earning MobyMax game time based on questions answered correctly. He adjusted the amount of MobyMax game time students earned by answering each question correctly. During a classroom observation, Mr. Beau mentioned that he adjusted the game time to provide extra incentive for his SPED students. He also mentioned that he often allows his students to use their MobyMax game time for the last ten minutes of class.

The overall theme was that Mr. Beau and the SPED students valued MobyMax and wanted to increase MobyMax use in the classroom. The discrepant data emerged with John's (SPED student participant) responses. John disagreed with the other SPED students and wanted to use MobyMax less. This discrepancy emerged within this case and across-case when compared to Mrs. Mary and the GE students. Additional information regarding John's responses and other across-case discrepancies are provided in the follow across-case analysis.

Across-Case Themes

Through examination of all data sources, the following themes and discrepancies emerged across both cases: *meeting individual student needs, differentiating instruction, and student engagement*.

Meeting individual student needs. The teachers believed MobyMax was successful in meeting individual student needs. In addition, teachers were able to choose whether to automatically or manually assign specific MobyMax lessons for students. Therefore, teachers were able to remediate or challenge students as needed. MobyMax fostered remediation by providing repetition of skills. MobyMax also provided additional student support via MobyMax tutorials. Lastly, the GE and SPED student participants were able to earn MobyMax game time which promoted excitement towards mathematics.

Differentiating instruction. The teachers used MobyMax to differentiate instruction in two fourth grade mathematics classrooms. Teachers also utilized the MobyMax read aloud feature in conjunction with headphones to assist struggling readers. In addition, teachers used MobyMax data reports to place students in small groups, which allowed for more individualized student support. Further, teachers used MobyMax data reports to monitor student progress and to inform curriculum decisions. Lastly, the teachers implemented MobyMax as a supplemental resource to their primary teacher-led instruction.

Student engagement. The majority of students believed MobyMax was a fun, helpful, and exciting way to learn fourth grade mathematics. Specifically, the students found the MobyMax tutorials to be helpful. The students also found the MobyMax games to be fun which made learning mathematics more exciting. In addition, the students enjoyed working with MobyMax via Chromebooks or computers. Lastly, Mrs. Mary and Mr. Beau noted a decrease in student behavior issues while students were working with MobyMax. The teachers attributed the reduction in student behavior issues to a higher level of student engagement.

Across-Case Discrepancies

For case study research, discrepant data challenges the theoretical proposition of the study (Yin, 2014). The theoretical proposition for this study was that computer-assisted instructional software (MobyMax) positively impacts differentiated instruction when a teacher implements this technology into mathematics instruction. The results of this study supported that theoretical proposition. Discrepant data, however, did emerge between the two teacher participants and some GE and SPED student participants within this study. The discrepant data emerged through cross-case analysis. Cross-case analysis explores whether the cases being studied had similar or different findings (Yin, 2014).

Discrepant data emerged regarding the teachers' perceptions of how well MobyMax satisfied individual student interests. Mrs. Mary believed that MobyMax did not incorporate student interests. Mrs. Mary stated, "MobyMax definitely does very well in the differentiation for their needs but not for their interests. I wouldn't say that every kid is going to be interested in MobyMax. MobyMax is really just one modality."

However, Mr. Beau believed MobyMax did meet individual student interests because most students enjoyed working on the computers. Mr. Beau stated, “Most of them liked to be on the computer. They thought it was a privilege, so it motivated them to earn MobyMax time.”

Discrepant data also emerged in relation to how the two teacher participants used the MobyMax program to assign student lessons. Mrs. Mary explained that she assigned specific skills for individual students and required students to redo lessons if they did not earn a 70 or above. However, Mr. Beau assigned the MobyMax placement test for each student and allowed the MobyMax program to automatically assign student lessons based on the placement test results.

Discrepant data emerged in relation to the teacher participants as well as the GE and SPED students’ perceptions of MobyMax. The MobyMax program required students to input answers in a specific way. Mrs. Mary believed that entering answers into MobyMax was sometimes challenging for the GE students and impeded their ability to be successful. Mr. Beau also agreed that answer input was sometimes challenging for his SPED students. Further, Mr. Beau modeled how to answer a MobyMax multiplication problem on the board for his students and encouraged the students to view the MobyMax tutorials.

In regards to the students, Sarah (GE student) noted, “I didn’t like it because sometimes it [MobyMax] explained it [multiplication] in a different way than Mrs. Mary and you get it wrong because you don’t know how to do it that way.” This is one example described by Sarah. However, the majority of the GE and SPED students explained that sometimes they were confused about how to submit answers when solving MobyMax multiplication problems.

Lastly, discrepant data emerged in student preferences about whether they would like to use MobyMax more or less than the amount of time they used it during the year-end review unit. All student participants stated they would like to use MobyMax more except for John (SPED student). John stated, “Less, because it takes a long time to do it.” In addition, John described how MobyMax is confusing and boring. He also described how difficult MobyMax was for him. However, John could not provide any additional reasons other than those reported above.

Evidence of Trustworthiness

Maxwell (2013) maintained the importance of reporting trustworthy results in an ethical manner. Trustworthiness is achieved by paying close attention to how data is collected, analyzed, and interpreted (Merriam, 2009). Miles et al. (2014) noted four issues of trustworthiness. The four issues are credibility, transferability, dependability, and confirmability.

Credibility

The credibility strategies utilized for this qualitative study were triangulation of data and member checking. Triangulation of data was a strategy that was used to establish credibility and dependability of the data findings. I achieved triangulation by collecting multiple modes of data. I analyzed the introductory and follow-up teacher interview transcripts, introductory and follow-up student focus group transcripts, classroom observations, and document (lesson plans) analysis. “Any case study finding or conclusion is likely to be more convincing and accurate if it is based on several different sources of information" (Yin, 2014, p. 120)

I also used member checking to establish credibility of the research findings. I utilized the member checking strategy to ensure accuracy of codes and categories derived from the introductory and follow-up teacher interview transcripts. In addition, I reviewed classroom observation and lesson plan codes and categories with the teacher participants via e-mail. Merriam (2009) maintained the importance of confirming data interpretations with research participants.

Transferability

Transferability is the degree to which research findings of a qualitative study can be transferred to other settings. I used rich, thick description of the setting, participants, and findings. I included direct quotes from the teacher interviews, student focus group interviews, and classroom observations. In addition, I recorded field notes during the teacher and student observations. Lastly, I maintained a reflective journal throughout the data analysis process. Maxwell (2013) suggested the rich, and thick descriptions of the data will provide sound grounding for, and test of, the conclusions of the study. Merriam (2009) also noted typicality of sample as another way to establish transferability. Typicality of sample is present when a researcher can describe how a case is typical compared with others in the same category. The proposed fourth grade mathematics classrooms for this study were typical of other fourth grade mathematics courses within this district and state.

Dependability

Dependability of a study involves determining whether the researcher's approach is consistent and dependable among other researchers. An example of evaluating dependability would be whether or not two or more different researchers coded the same passage with similar codes. For this study, I utilized three content specialists to review the teacher and student focus group interview guides. The content specialists evaluated each interview question and determined their relevance to the study during the review. I reflected on the feedback provided by each content specialist and made the appropriate revisions. I also utilized two content specialists (my dissertation committee) to crosscheck codes developed to ensure consistency. Finally, I reviewed transcripts to make sure there were no errors made during transcription (Maxwell, 2013).

Confirmability

Confirmability is the degree to which the research findings of a qualitative study can be confirmed by other individuals (Miles et al., 2014). Reflexivity, a strategy to enhance confirmability, requires self-reflection of the researcher to identify potential biases that might affect the research study (Merriam, 2009). Creswell (2009) described how background, gender, culture, history, and socioeconomic origin could influence a researcher's interpretation of the findings. These are examples of researcher bias. As an elementary school teacher, I am evaluated on 10 standards. One of those standards is differentiated instruction; therefore, I make an earnest effort to document my differentiated instruction strategies in my lesson plans. Due to the use of differentiation in my daily instruction, I recorded notes of my own personal experiences and perceptions of differentiated instruction within a reflection journal throughout the data analysis process.

Results

In this section, I reintegrated the findings derived from the within-case and across-case themes to answer the related and central research questions. Next, I analyzed each related research question in order to build up to the central research question. Finally, I analyzed the central research question which included a synthesis of all of the findings for this study.

The first related research question asked, "How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?" The teachers believed MobyMax was successful in meeting individual student needs. Teachers also valued the capability to choose whether to automatically or manually assign specific MobyMax lessons for students. Further, teachers valued the capability to remediate or challenge students as needed. Mary expounded on why she believed MobyMax was able to meet the individual needs of all students during the year-end review unit. Mrs. Mary stated,

> MobyMax basically remediated the students itself. MobyMax was able to differentiate to the students a lot better than I could. MobyMax assigned the students specific skills rather than having a group of students who I might have met one or two of those skills. I just thought MobyMax did a better job, it was more specific.

Mr. Beau explained, “I believe it [MobyMax] worked as a good tool to provide individual learning practice at a pace that each student was comfortable or needed.”

The teachers believed MobyMax promoted excitement towards mathematics and increased student engagement. Mrs. Mary believed a higher rate of exposure and practice with MobyMax increased student engagement and mastery of skills. The teachers also believed the students’ ability to earn MobyMax game time, based on the number of correct responses, increased student engagement. Finally, the teachers believed this promoted excitement towards MobyMax and the mathematics lessons.

During the classroom observations, I observed many instances where Mr. Beau knelt beside each individual student while they worked with MobyMax. Mr. Beau aimed to monitor student progress and provide individual assistance as needed. The planned lessons from each teacher provided evidence that MobyMax was implemented in small group instruction to better meet the needs of students. In summation, teacher interviews, classroom observations, and teacher lesson plans supported this finding.

The second related research question asked, “How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?” The majority of students believed MobyMax was a fun and helpful way to learn fourth grade mathematics. More specifically, the students found the MobyMax tutorials to be helpful. The students also found the MobyMax games to be fun which made learning mathematics more exciting. Lastly, the students enjoyed working with MobyMax via Chromebooks or computers.

The majority of GE and SPED student participants wanted to use MobyMax more often because MobyMax explained the mathematics problems in a manner they could understand. Griffin (GE student) added, “I liked the math because when you got an answer wrong, it [MobyMax] showed you what you did wrong and it will be a little spot up there that taught you how to do it so next time you can get it right.” Griffin was describing the icon for the MobyMax tutorials. The students collectively reported enjoying the MobyMax games and the lessons they considered to be easy. Luke (SPED student) explained, “The part I liked was when you get to play games and watch cool videos on MobyMax.” In summation, student focus group interviews and classroom observations supported this finding.

The third related research question asked, “How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?” The finding was that the MobyMax program differentiates instruction for students by providing specific lessons and tutorials based on the students’ progress. Further, this finding described how the teachers modified their instruction to support the range of MobyMax lessons. During the student focus group interviews and classroom observations, GE student participants and SPED student participants mentioned that their teachers provided individual assistance when needed. The teacher participants believed MobyMax time was great for personally assisting students in need.

When the teachers integrated MobyMax into mathematics instruction, differentiated instructional opportunities emerged for the teachers and students by providing additional modifications for struggling students such as assistive technology. Struggling readers were allowed to use headphones and the read aloud feature to assist them when working on MobyMax word problems. During the second classroom observation Mr. Beau stated, “Many of the special education students have an Individualized Education Plan that allows them to have classroom assessments and state assessments read aloud.” He explained that it would be impossible for him to read aloud the various MobyMax word problems for each of his students. Mr. Beau stated, “The MobyMax read aloud feature was a great way to determine whether his students understood how to solve a particular word problem instead of the student giving up because he/she cannot read the problem.” In summation, teacher interviews, student focus group interviews, classroom observations, and teacher lesson plans supported this finding.

The central research question asked, “How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?” All data sources supported the finding that MobyMax was used to remediate and enrich student learning based on individual student needs. Teachers used MobyMax to implement small group instruction, which allowed for more individualized student support. Teachers also used MobyMax data reports to monitor student progress and to inform curriculum decisions. Further, teachers utilized the MobyMax read aloud feature, in conjunction with headphones, to assist struggling readers. Lastly, teachers implemented MobyMax as a supplemental resource to their primary teacher-led instruction.

Mrs. Mary believed it was vital to monitor student progress and assign specific lessons as necessary. Mrs. Mary required struggling students to redo lessons and assigned fifth grade standards for advanced students. Mrs. Mary stated,

> I pulled MobyMax reports at the end of each week to see whether the students were working on grade level. Specifically, I looked to see whether students were moving down or moving up. I looked to see if there was a specific skill that students needed to repeat.

Mrs. Mary believed that MobyMax was capable of and effective at providing remedial instruction for her students. Further, Mrs. Mary stated,

> If I wanted to go along with the program based on student placement test scores, there was absolutely nothing I had to do. Now of course, I went in and made some changes just based on what I saw a kid was having some issues with that might not have shown up on that test. But it's a great program.

With this comment, Mrs. Mary referred to the ability for the teacher to choose whether he/she would elect for MobyMax to automatically assign student lessons based on placement test results or whether the teacher would manually assign specific lessons. Moreover, Mr. Beau believed MobyMax aided the ability to differentiate instruction by supplementing and modifying instruction for more individualized student support. He noted that his classes are comprised of different learning levels; therefore, he modified the time based on student ability. Some students are above or on grade level while some are below grade level. However, Mr. Beau primarily elected for students to work on lessons automatically assigned by the MobyMax program.

Further, Mrs. Mary and Mr. Beau both used MobyMax as a supplemental resource to their primary teacher led instruction. Mrs. Mary explained how she preferred to introduce and teach skills via teacher led whole group instruction. Mrs. Mary stated,

> My students don't decide, but I decide how to use MobyMax. I used it daily in a center. I used it as a practice method, I didn't really use it as instruction, and it's more of a practice to reinforce the skills we have learned or the skills they were weak on.

Likewise, Mr. Beau expressed the viewpoint that computer-assisted instruction is a supplementary resource used to remediate student learning and it allowed for small group instruction. He stated,

> It was a supplementary program to what I'm taught or what I'm reviewing. It was a way for me to break students into smaller groups. The computer can occupy two or three students at a time while I worked with two or three students at a time or while some others were doing independent work.

Mr. Beau believed there was limited time to implement MobyMax because he primarily used the program as a supplementary resource. Similar to Mrs. Mary, he preferred to introduce and teach the standards via teacher led instruction.

Thus, both teachers believed it was worth their time and effort to implement MobyMax into the year-end review unit. During classroom observations, I observed that the GE and SPED student participants were slouched in their seats, looking around the room, and sighing out loud when working on the paper worksheets. The GE and SPED student participants seemed to put forth more effort while working with MobyMax.

While working with MobyMax, GE and SPED student participants laughed at images displayed on the screen, made positive comments when answering questions correctly, and maintained focus on the Chromebook or computer screen. During classroom observations, I also observed evidence of differentiated instruction through increased student excitement and engagement, different methods of instruction, and providing varying levels of support for each student while working with MobyMax. All data sources supported the key finding for the central research question.

Table 14 presents a summary of the results for this study in relation to the related and central research question.

Table 14

Summary of Key Findings

Research Questions	Key Findings
RQ1: Teacher perceptions	Meeting individual student needs
	Providing remediation and enrichment
	Increasing student engagement
	Reducing student behavior issues
	Increasing student excitement towards mathematics
RQ2: Student perceptions	Using MobyMax is fun
	Enjoying MobyMax games
	Learning mathematics from the MobyMax tutorials

Research Questions	Key Findings
RQ3: Differentiated instruction opportunities	Assigning lessons based on individual student cognitive level
	Implementing small group instruction
	Monitoring student progress
Central RQ: Teacher use	Meeting individual student needs
	Monitoring student progress
	Implementing small group instruction
	Increasing student engagement
	Supplementing primary teacher-led instruction

Summary

In summary, this study revealed that teachers and students believed computer-assisted instruction (MobyMax) supported the differentiated instruction for individual students within one general education fourth grade mathematics classroom and one special education fourth grade mathematics classroom. In addition, this study revealed that teachers and students believed MobyMax increased student engagement and excitement towards mathematics. Lastly, this study revealed that teachers and students believed the implementation of MobyMax reduced behavior issues and positively impacted the teachers' ability to meet individual student needs within one general education fourth grade mathematics classroom and one special education fourth grade mathematics classroom.

Chapter 5 includes an interpretation of the findings. It includes an introduction, which restates the purpose and nature of the study, an interpretation of the findings in relation to the literature review and the conceptual framework of the study (i.e., constructivism theory). In addition, chapter 5 includes a discussion of the limitations and recommendations for future research, and implications for social change. Lastly, chapter 5 includes a conclusion, which reports the significance of the study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative, embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. In the framework and methods synthesis within Chapter 2, I reported that other researchers have conducted quantitative, qualitative, and mixed-methods studies on computer-assisted instruction and differentiated instruction. However, few qualitative studies were found on computer-assisted instruction as a differentiated instruction tool in elementary mathematics classrooms.

In addition, the constructivism theory was the most common theoretical lens derived from the framework and methods synthesis within Chapter 2 of this study. Further, in the findings of this study, I presented teacher and student perceptions of computer-assisted instruction as a differentiated instruction tool through the lens of constructivism theory. Lastly, I discuss how the constructivism theory was used to interpret the data for this study within the subsequent section.

The finding for the first related research question was that Mr. Beau and Mrs. Mary believed MobyMax was an effective resource for meeting the needs of individual students. The teachers believed that MobyMax included the capability to provide instruction for students of varying ability levels and to satisfy various learning styles. Notably, teachers were able to provide assignments for each of their students.

The finding for the second related research question was that the majority of the students believed that MobyMax was a fun and helpful way to learn fourth grade mathematics. The students also reported excitement towards MobyMax games and the opportunity to earn MobyMax game time by answering questions correctly. Lastly, the students discussed their favorite MobyMax games with their peers and compared the amount of game time they earned against the amount of time earned by their peers.

The finding for the third related research question was that the MobyMax program differentiates instruction for students by providing lessons and tutorials based on the students' progress. Teachers are looking for resources to supplement instruction. The teachers believed MobyMax was a supplemental resource to their primary instruction.

Lastly, the finding for the central research question was that Mr. Beau and Mrs. Mary used MobyMax to remediate and enrich student learning based on individual student needs. The teachers chose to implement MobyMax differently within their individual classrooms. However, the teachers believed that their method of implementation was best suited for their students. The findings for this study are discussed in greater detail in the subsequent interpretations of findings section. In this chapter, I also report the limitations of the study, recommendations for future research, implications for social change, and conclusion to the study.

Interpretations of Findings

First, I present the interpretation of the findings for the related research questions. Then, I present the interpretation of the findings for the central research question. The findings for the central research question include a synthesis of the findings from the related research questions.

Teacher Perceptions of Computer-Assisted Instruction

The first related research question asked, “How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?” There were five key findings for this research question. The five key findings were that teachers believed MobyMax was successful in meeting individual student needs, providing remediation and enrichment for students, increasing student engagement, reducing behavior issues, and increasing student excitement towards mathematics.

The first key finding for related Research Question 1 was that MobyMax was successful in meeting individual student needs. Further, Shepherd and Acosta-Tello (2014) recognized the need to customize lessons for students based on their prior knowledge and individual needs. Shepherd and Acosta-Tello also described a three-phase lesson comprised of a basic lesson for remedial students, core lesson for average students, and an enrichment lesson for advanced students. Similarly, I found that teachers valued the capability to assign MobyMax lessons of varying levels of difficulty for students. The teachers increased the rigor of MobyMax lessons as students progressed. Notably, McFarlane (2013), Scott et al. (2011), and Slaten et al. (2013) described how teachers can use computer-assisted instruction to provide content that has been adapted to the cognitive level of each student.

The second key finding for related Research Question 1 was that MobyMax was successful in providing remediation and enrichment for students. As an elementary teacher, I understand the difficulty in finding instructional materials for remediation and enrichment. Dixon et al. (2014), Tobin and Tippett (2014), and Callahan et al. (2005) discussed the difficulty in meeting the needs of all students. Mr. Beau and Mrs. Mary considered MobyMax beneficial because it included instructional lessons, student support, assessments, and games. In addition, Mr. Beau and Mrs. Mary valued MobyMax because it decreased the amount of time they spent searching for instructional resources to accommodate each of their students. Tomlinson (2005) explained that the best way to meet student needs is to provide instruction and support for each student. Based on the teacher interview responses, Mr. Beau and Mrs. Mary believed that MobyMax reduced the difficulty in differentiating instruction for their students.

The third key finding for related Research Question 1 was that MobyMax was successful in increasing student engagement for fourth grade mathematics GE and SPED students. I believe student engagement increased due to the use of Chromebooks, ipads, and the MobyMax program. Burakgazi and Yildirim (2014), Ebrecht and Ku (2015), Sad and Ozhan (2012), and Slaten et al. (2013) reported positive student engagement of students when employing computer-assisted instruction. With exception of Slaten et al., the additional three scholars (Burakgazi & Yildirim, 2014; Ebrecht & Ku, 2015; Sad & Ozhan, (2012) all explored student engagement of elementary students. In addition, maintaining student focus and engagement is a difficult task for all educators. Therefore, providing various modes of instruction helps reduce inattentiveness and boredom for students. Further, employing MobyMax via Chromebooks and ipads allowed the students to experience a different mode of instruction.

The fourth key finding for related Research Question 1 was that MobyMax was successful in reducing student behavior issues. In relation to reducing behavior issues, Mr. Beau and Mrs. Mary attributed the reduction in behavior issues to increased student engagement. As an educator, I have observed that behavior issues arise when there is too much downtime for students. Consequently, when students are engaged in classroom instruction, there is less student downtime. Based on teacher interview and classroom observation data, Mr. Beau and Mrs. Mary believed that when students are actively engaged, they are less likely to misbehave.

The fifth key finding for related Research Question 1 was that Mr. Beau and Mrs. Mary believed MobyMax was successful in increasing student excitement towards mathematics. The teacher interview data for this study revealed that teachers believed students became more excited and engaged when working with MobyMax than with other modes of instruction. Hunter (2012), Lewis (2010), and Ritzhaupt et al. (2011) conducted quantitative studies that examined the effects of computer-assisted instruction on student attitudes towards mathematics. An analysis of covariance was used to measure the effects of instructional type on student attitudes towards mathematics. The findings of their studies revealed an improvement in student attitudes towards mathematics. In addition, Yildiz and Aktas (2015) reported the average scores of the mathematics attitude scale were significantly higher for the students exposed to computer-assisted instruction. Furthermore, an overall theme derived from student focus group interview and classroom observation data for this study revealed that the GE and SPED students demonstrated positive attitudes towards MobyMax and requested more time to use the program.

Student Perceptions of Computer-Assisted Instruction

The second related research question asked, "How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?" There were three key findings for this research question. The three key findings were that the majority of students believed MobyMax was fun, students enjoyed the MobyMax games, and students enjoyed learning from MobyMax tutorials.

The first key finding for related Research Question 2 was that the GE and SPED student participants believed MobyMax was fun. Student focus group interviews and classroom observation data revealed the students' excitement for using MobyMax. Liu and Wu (2011) explored whether students' positive perceptions in technology rich environments were only a temporary effect. Liu and Wu (2011) also explained that sometimes it can be a challenge to maintain student excitement towards learning. The results of their study revealed that students had positive perceptions of enjoyment, assistance, and effectiveness of computer-assisted instruction after nine months. In comparison, the GE and SPED student participants in the current study requested more time to work with MobyMax.

The second key finding for related Research Question 2 was that the GE and SPED student participants enjoyed playing MobyMax games. In relation to educational games, Abrams (2008) conducted a mixed methods study that examined the effects of educational games on elementary and middle school students who were below grade level academically in the subject area of mathematics. The findings for her study revealed an improvement of students' self-efficacy for learning mathematics and improving their interest in mathematical activities. According to Trinter (2015), "One unique way of differentiating instruction is by incorporating differentiated educational games into the mathematics curriculum" (p. 88). Further, the GE and SPED student participants in the current study described the MobyMax games as fun and exciting. The students were aware that MobyMax game time was earned by answering questions correctly. Therefore, the students seemed to take more time and put forth more effort when answering the MobyMax questions. The students also demonstrated more excitement when answering MobyMax questions correctly than with any other mode of instruction. Tsai, Yu, and Hsaio (2012) noted that digital game based learning positively influences student motivation to learn, but does not fully reveal the power to increase student knowledge acquisition.

The third key finding for related Research Question 2 was that students valued learning via MobyMax tutorials. The GE and SPED student participants enjoyed the MobyMax tutorials due to the animated graphics and instructional methods presented. Several student participants mentioned that the MobyMax lessons and tutorials presented the information in a way that was easy to understand. Hunter (2012), Kengwee et al. (2012), Lewis (2010), and Shamir et al. (2014) all reported positive student engagement and attitudes towards intelligent tutoring systems similar to MobyMax tutorials.

Differentiated Instruction

The third related research question asked, "How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?" There were three key findings for this research question. The three key findings for this research question were that the MobyMax program differentiated instruction for students by assigning specific lessons based on individual student cognitive levels, implementing small group instruction, and monitoring student progress.

The first key finding for related Research Question 3 was that MobyMax differentiated instruction for students by assigning specific lessons based on individual student cognitive levels. Logan (2011) discussed the importance of providing students with appropriate instruction to help them meet their learning targets. During the teacher interviews, Mr. Beau and Mrs. Mary provided similar definitions for differentiated instruction. However, they assigned MobyMax lessons differently in their classrooms. This finding was expected due to the need for each teacher to employ MobyMax in the best way to teach their specific students. Since each student has their unique needs and preferences, we should not expect to implement computer-assisted instruction the same in all educational settings. In addition, Tomlinson (2013) described differentiated instruction as an approach that requires modification of teaching strategies and methods to satisfy the needs of diverse learners. Therefore, the findings of this study described the perceptions and recommendations for teachers implementing computer-assisted instruction to meet the needs of diverse learners.

The second key finding for related Research Question 3 was that MobyMax differentiated instruction via small group instruction. In relation to small group instruction, Mr. Beau and Mrs. Mary believed MobyMax was a great resource to use in small group instruction. The teachers seemed to consider MobyMax as an extra teacher in the classroom. During small groups, the students received direct instruction from the MobyMax lessons while the teachers circulated the room and provided support when needed. In addition to teacher support, Mrs. Mary also allowed students to assist their peers with MobyMax lessons during small group instruction. Kolloffel, Eysink, and Jong (2011) stated that peer tutoring is a research-based instructional strategy that receives lots of attention in mathematics instruction. Mrs. Mary implemented an “ask three before me” strategy in her classroom. Students were encouraged to seek assistance from three peers before asking the teacher. However, Mr. Beau primarily circulated the room and provided support himself, limiting the opportunities for peer tutoring. Therefore, it seemed that MobyMax was a great method of providing multiple modes of presenting the mathematics lessons.

The third key finding for related Research Question 3 was that MobyMax was an effective tool for monitoring student progress. Mr. Beau and Mrs. Mary reported that MobyMax was capable of both formative and summative assessments. The teachers also described the MobyMax progress data as a formative assessment that was used to guide classroom instruction. Peshek (2012) stated that formative assessment information is the foundation for instructional decisions about student readiness. Specifically, the teachers assigned MobyMax placement tests as a summative assessment to identify the overall cognitive level of their students. Logan (2011) reported that teachers who take the time to monitor student progress are able to assign lessons at each student’s cognitive level.

Teacher Use of Computer-Assisted Instruction

The central research question asked, "How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?" The findings for all related research questions were analyzed and interpreted to answer the central research question. There were five key findings for the central research question. The five key findings were that teachers used MobyMax to assist in meeting individual student needs, monitor student progress, implement small group instruction, increase student engagement, and supplement primary teacher-led instruction. The first key finding for the central research question was that Mr. Beau and Mrs. Mary used MobyMax to assist in meeting individual student needs. In addition to using computer-assisted instruction to meet individual student needs (Higgins et al. 2016; Musti-Rao & Plati, 2015; Yildiz & Aktas, 2015), teachers used computer-assisted instruction to provide a variety of instructional modes to better differentiate instruction for students of varying ability levels (Kolloffel et al. 2011; Logan, 2011; Tomlinson, 2013).

The second key finding for the central research question was that Mr. Beau and Mrs. Mary used MobyMax to monitor student progress. In relation to monitoring student progress, teachers and students seemed to value the immediate feedback provided by the MobyMax program. The teachers were able to see how well the students performed on the MobyMax lessons; therefore, they were able to provide remediation or enrichment right away. The students seemed to be more engaged because they were able to monitor their own progress in real time. As reported earlier, Peshek (2012), Chinman et al.

(2014), and Espey and Brindle (2010) all explained the effectiveness of progress monitoring for meeting individual student needs.

The third key finding for the central research question was that Mr. Beau and Mrs. Mary used MobyMax to implement small group instruction. The teachers valued the flexibility of choosing how to implement MobyMax in their classroom. They also believed the flexibility of choosing how to implement MobyMax and the vast capabilities of the program were the items that made differentiating instruction successful. More specifically, Mr. Beau chose to limit peer to peer tutoring. Therefore, he provided the majority of support for his students. Perhaps, Mr. Beau made the decision to limit student support based on the cognitive level of his SPED students. Further, his students may have lacked the confidence or cognitive ability to act as peer tutor for another student. However, Mrs. Mary relied heavily on peer to peer tutoring while employing MobyMax and only provided teacher support once students had consulted three of their peers. Tomlinson (2013) noted the benefits of small group instruction when differentiating classroom instruction. Lastly, the findings of this study support the benefits and effectiveness of employing computer-assisted instruction within small group to achieve more individualized student support.

The fourth key finding for the central research question was that Mr. Beau and Mrs. Mary believed the implementation of MobyMax increased student engagement. Notably, MobyMax was capable of identifying the students' cognitive levels. Therefore, students were not wasting time working on lessons that were too easy or too difficult. MobyMax also included instructional tutorials for students to access immediately upon encountering a problem they found difficult. Therefore, the teachers believed MobyMax increased student engagement because it provided real time progress monitoring for the teachers and students. In addition, students were able to earn MobyMax game time based on the number of correct responses. I believe these examples are why the teachers believed MobyMax increased student engagement. There is a vast collection of research that supports teacher use of computer-assisted instruction to increase student engagement (Abrams, 2008; Baker, 2014; Burakgazi & Yildirim, 2014; Ebrecht & Ku, 2015; Higgins et al. 2016; Hunter, 2012; Ku et al., 2007; Lewis, 2010; Maloy et al., 2014; Musti-Rao & Plati, 2015); Ojalainen & Pauna, 2013; Ritzhaupt et al., 2011; Sad & Ozhan, 2012; Slaten et al., 2013; Yildiz & Aktas, 2015).

The fifth key finding for the central research question was that teachers believed MobyMax was essential in supplementing their primary teacher-led instruction. Teacher interviews and classroom observations yielded data that indicated both teacher participants used MobyMax as a supplement to their teacher-led instruction. Mr. Beau and Mrs. Mary preferred to introduce and teach new skills via whole group teacher-led instruction. As an elementary teacher, I understand this is not uncommon for most educators. I believe the real work for a teacher begins once the initial instruction of a new skill has been provided. I also believe the teacher must decide how to present the content differently for struggling students and dig deeper into the content for students in need of enrichment. In addition, Mr. Beau and Mrs. Mary seemed to rely on MobyMax tutorials as a means of presenting information for struggling students. The teachers and students found the MobyMax tutorials helpful. During the student focus group interviews, many students mentioned the MobyMax tutorials presented the information in a way that was easy to understand. Notably, VanLehn (2011) conducted a quantitative study that compared computer-tutoring systems to human tutoring for elementary learners. Based on the findings of VanLehn (2011) and this study, teachers may be encouraged to implement a computer-assisted instructional program to support their primary teacher-led instruction.

Theoretical Framework

The findings for this study were interpreted through the lens of constructivism theory and informed by the literature review. Dewey's (1938) constructivism theory describes the importance of meeting the individual needs of all students. Further, Dewey believed educators should relate content to prior knowledge, experiences, and interests in order for students to make connections to the content. Therefore, the constructivism theory worked well for data analysis and interpretation within this study.

More specifically, I focused on the behaviors, level of engagement, and interactions between the teachers and students while analyzing and interpreting the data. The focus on behaviors, level of engagement, and interactions between the teachers and students was imperative to explore how the teacher related prior knowledge, experiences, and interests of students while employing computer-assisted instruction. This was also necessary in order to explore how teachers utilized computer-assisted instruction to meet the needs of students.

As previously mentioned, many studies in the literature review identified the use of John Dewey's (1938) constructivism theory in conjunction with computer-assisted instruction and differentiated instruction (Abrams, 2008; Baker, 2014; Hunter, 2012; Kale & Goh, 2011; Keengwe et al., 2012; Ku et al., 2007; Lewis, 2010; Maloy et al., 2014; Moore-Hayes, 2011; Proscia et al., 2010; Ojalainen & Pauna, 2013; Ritzhaupt et al., 2011; Schoppek & Tullis, 2010; Scott et al., 2011; Shamir et al., 2011; VanLehn, 2011). In addition, the constructivism theory as a theoretical framework could be beneficial for future research on this topic. The focus on behaviors, level of engagement and interactions between students and teachers would be important when exploring computer-assisted instruction and differentiated instruction over a longer period of time, within a different population, at a different time of the school year, or utilizing a different program as the vehicle for the study. Finally, further recommendations for future research are provided within the recommendation for future research section of this chapter.

Limitations of the Study

Three limitations were identified as a result of the research design for this study. The first limitation is due to a small teacher and student participant sample. The participants in this study included one GE fourth grade mathematics teacher, one SPED fourth grade mathematics teacher, six GE fourth grade students, and four SPED fourth grade students. Therefore, the findings for this study may not be representative of all fourth grade mathematics teachers at Holly Hills Elementary.

The second limitation is related to data collection. The data collection timeframe for this study was six weeks, which took place near the end of the 2015-2016 school year. I conducted two interviews for each teacher participant, two interviews for each student focus group, two classroom observations for each class, and weekly lesson plans from each teacher. However, two observations for each class may not provide an adequate understanding of how teachers and students used MobyMax. Multiple observations over an extended period of time could have provided additional data to answer the research questions.

The third limitation is related to one of five concerns to using case study research described by Yin (2014). This concern is that generalization of the research findings could be difficult based on the limitations listed above. However, Yin (2014) explained that case studies are able to be generalized to theoretical propositions and not to represent a sample. The theoretical proposition for this study was that computer-assisted instructional software (MobyMax) positively impacts differentiated instruction when a teacher implements this technology into mathematics instruction. The results of this study supported that theoretical proposition.

Recommendations for Future Research

The recommendations for future research are based on the strengths, limitations, findings, and literature review for this study. The first recommendation is that researchers should replicate this study over a longer period of time, include more instructional units, and recruit a larger participant sample that includes more than one elementary school. The items listed within the first recommendation could provide better understanding of how a teacher uses computer-assisted instruction to meet the needs of all learners.

The second recommendation is to replicate this study in urban schools. This study was conducted in a low socioeconomic status school in a rural area. The student participants for this study have limited access to technology at home. Therefore, their perceptions could have been guided by lack of exposure to such technology. Student participants with a higher rate of exposure to technology may report different levels of engagement and excitement towards computer-assisted instruction.

The third recommendation is to replicate this study at a different time of the school year. This study was conducted near the end of the 2015-2016 school year, while students were preparing and taking the Georgia Milestones Assessment. In addition, the spring break holiday took place during the data collection timeframe. However, the six week data collection timeframe described throughout the dissertation describes actual weeks where school was in session. Conducting this study at a different point of the school year could yield a better understanding of how teachers use computer-assisted instruction to meet the needs of all learners.

The fourth recommendation is to explore the teacher and student perceptions of computer-assisted instruction as a differentiated instruction tool utilizing a different program as the vehicle for the study. MobyMax was used as the vehicle for this study. The findings for this study revealed limitations of the MobyMax program. Therefore, GE and SPED student perceptions were guided by their specific experiences with the MobyMax program. The students reported negative perceptions towards MobyMax due to specific answer input methods required by the program. Therefore, conducting a study using a different computer-assisted program would be valuable.

Implications for Social Change

The results from this study provide several contributions to positive social change. The first contribution is the advancement to the profession of educational technology by revealing teacher and student perceptions of utilizing technology to meet the academic needs of students. The findings for this study expand the understanding and relevance of computer-assisted instruction and differentiated instruction. This study also advances the profession of educational technology by reporting recommendations from both teachers and students about how computer-assisted instruction can be improved in an elementary classroom. The findings for this study yielded student perceptions that described the importance of the teacher's role while students are working with a computer-assisted instructional program.

The second contribution of this study to positive social change is to provide teachers with an increased repertoire of instructional strategies to assist in meeting the needs of all learners. The findings of this study reported several varieties of teacher-student, student-student, teacher-program, and student-program interactions. Students were able to demonstrate mastery of skills by tutoring their peers. In addition, struggling students were able to receive a variety of modes of instruction via teacher-led instruction, peer tutoring, MobyMax lessons, and MobyMax tutorials. The increased interaction between students could promote a positive learning community. This could ultimately increase student mathematics achievement and assist in overcoming the national mathematics achievement deficit.

The third contribution of this study to positive social change is to prepare students for a technology driven world. Computers are ever present in all aspects of life. Students will be required to work with computers in most careers, online courses, and/or daily activities. This study explored student perceptions and experiences of using computer-assisted instruction to learn new information. Further, this study provided the opportunity for teachers and students to have a voice in improving the use of computer-assisted instruction. Therefore, this study assists in improving student experiences with utilizing computer-assisted instructional programs for the purpose of acquiring new information.

Conclusion

The purpose of this qualitative embedded, multiple case study was to explore the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. The results from this study add to the literature of educational technology about how teachers and students can improve the use of computer-assisted instruction to meet the needs of all learners. This study revealed that teachers and students believed computer-assisted instruction (MobyMax) supported the differentiated instruction for individual students within one general education and one special education fourth grade mathematics classroom. In addition, this study revealed that teachers and students believed MobyMax increased student engagement and excitement towards mathematics. However, the results of this study were limited to one school with a small sample of teacher and student participants. Therefore, the results of this study may not reflect the perceptions of teacher and students in different settings.

This study expands the understanding and relevance of computer-assisted instruction and differentiated instruction. Computer-assisted instruction has the ability to change student attitudes toward learning mathematics and increase student engagement. I believe the combination of computer-assisted instruction and differentiated instruction presents the ability to change a student's learning experience, an entire classroom environment, an entire school, or the entire field of education.

References

Abrams, L. (2008). The effect of computer mathematics games on elementary and middle school students' mathematics motivation and achievement. *Humanities and Social Sciences*, *69*(1), 147-171 . Retrieved from EBSCOhost database.

Acosta-Tello, E., & Shepherd, C. (2014). Equal access for all learners: Differentiation simplified. *Journal of Research in Innovative Teaching, 7*(1), 51-57. Retrieved from EBSCOhost database.

Anderson, C., & Anderson, K. (2013). Study of udl-based mathematics games in three inclusive fourth grade classrooms. *Proceedings of Society for Information Technology & Teacher Education International Conference, 2013*, 2676-2683. Chesapeake, VA: AACE.

Baker, A. (2014). *The relationship between classworks and Georgia state testing* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Full Text database. (UMI No. 3617054)

Bastedo, M. N. (2009). Conflicts, commitments, and cliques in the university: Moral seduction as a threat to trustee independence. *American Educational Research Journal, 46*(2), 354–386. Retrieved from EBSCOhost database.

Bazeley, P. (2007). *Qualitative data analysis with NVivo.* Thousand Oaks, CA: Sage Publications, Inc.

Bitter, G. G., & Hatfield, M. M. (1998). The role of technology in the middle grades. In L. Leutzinger (Ed.), *Mathematics in the middle* (pp.36-41). Reston, VA: National Council of Teachers of Mathematics.

Blanken-Webb, J. (2014). The difference differentiation makes: Extending Eisner's account. *Educational Theory, 64*(1), 55-74. Retrieved from EBSCOhost database.

Brown, L., & Johnson, D. (2014). The impact of Moby Max, an individualized computer-assisted instruction, on math assessment scores of middle grade students. *Proceedings of Society for Information Technology & Teacher Education International Conference 2014*. Chesapeake, VA: AACE.

Burakgazi, S. G., & Yildirim, A. (2014). Accessing science through media: Uses and gratifications among fourth and fifth graders for science learning. *Science Communication, 36*(2), 168-193. doi: 10.1177/1075547013505847

Buyukkoroglu, T., Cetin, N., Deniz, A., Duzce, S. A., Mahir, N., & Ureyen, M. (2006). The effect of computers on teaching the limit concept. *International Journal for Mathematics Teaching and Learning*, *3*, 1-12. Retrieved from EBSCOhost database.

Callahan, C., Tomlison, C., Moon, T., Brighton, C., & Hertberg, H. (2003). *Feasibility of high end learning in middle grades.* Charlottesville, NC: University of Virginia.

Chang, N. (2001). It is developmentally inappropriate to have children work alone at the computer? *Information Technology in Childhood Education Annual, 2001*. Norfolk, VA: AACE.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis.* Thousand Oaks, CA: Sage Publications, Inc.

Chinman, M., Imm, P., & Wandersman, A. (2004). *Getting to outcomes: Promoting accountability through methods and tools for planning, implementation, and evaluation*. Santa Monica, CA: RAND Corporation.

Clark, A. K., & Whetstone, P., (2014). The impact of an online tutoring program on mathematics achievement. *The Journal of Educational Research, 107*(6), 462-466. doi:10.1080/00220671.2013.833075

Cobb, A. (2010). To differentiate or not to differentiate? Using internet-based technology in the classroom. *Quarterly Review of Distance Education*, *11*(1), 37-45. Retrieved from EBSCOhost database.

Cooperstein, S. E., & Kocevar-Weidinger, E. (2004). Beyond active learning: A constructivist approach to learning. *Reference Services Review, 32*(2), 141-148. Retrieved from EBSCOhost database.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

De Jesus, O. N. (2012). Differentiated instruction: Can differentiated instruction provide success for all learners? *National Teacher Education Journal, 5*(3), 5-11. Retrieved from EBSCOhost database.

Dewey, J. (1938). *Experience and education*. New York: Macmillan.

Dixon, F. A., Yssel, N., McConnel, J. M., & Hardin, T. (2014). Differentiated instruction, professional development, and teacher efficacy. *Journal for the Education of the Gifted, 37*(2), 111-127. Retrieved from EBSCOhost database.

Driscoll, M. P. (2005). *Psychology of learning for instruction* (3rd ed.). Boston, MA: Pearson.

Ebrecht, B.M., & Ku, H.Y. (2015). A case study of classroom blogging in three elementary schools. *Journal of Educational Research and Innovation, 4*(1), 1-22. Retrieved from EBSCOhost database.

Eisner, E. W. (2004). What can education learn from the arts about the practice of education? *International Journal of Education & the Arts, 5*(4), 1-13. Retrieved from EBSCOhost database.

Espey, L., & Brindle, S. (2010). Click, click, wow! Engaging students with student response systems. *Proceedings of Society for Information Technology & Teacher Education International Conference 2010* (pp. 2708-2714). Chesapeake, VA: AACE.

Georgia Department of Education. (2015). Enrollment by Ethnicity/Race, Gender and Grade Level. Retrieved December 21, 2015 from https://app3.doe.k12.ga.us/ows-bin/owa/fte_pack_ethnicsex.entry_form.

Gibson, D. C., Knezek, G., Redmond, P., & Bradley, E. (2014). *Handbook of games and simulations in teacher education*. Chesapeake, VA: AACE.

Governor's Office of Student Achievement. (2013). A snapshot of k-8 academic achievement in Georgia. Retrieved from http://gosa.georgia.gov/snapshot-k-8-academic-achievement-georgia.

Grabe, M., & Grabe, C. (2006). *Integrating technology for meaningful learning* (3rd ed.). New York, NY: Houghton Mifflin Company.

Hamilton, E. (2008). Computer-assisted instruction. *Research Starters Education*, 1-13. Retrieved from EBSCOhost database.

Hartnett, M., & Edmunds, B. (2014). Using a learning management system to personalize learning for primary school students. *Journal of Open, Flexible, and Distance Learning, 18*(1), 11-29. Retrieved from EBSCOhost database.

Hays, R. T. (2005). *The effectiveness of instructional games: A literature review and discussion*. Orlando, FL: Naval Air Warfare Center.

Higgins, K. N., Crawford, L., Huscroft-D'Angelo, J., & Horney, M. (2016). Investigating student use of electronic support tools and mathematical reasoning. *Contemporary Educational Technology, 7*(1), 1-24. Retrieved from EBSCOhost database.

Hooper, S., & Rieber, L. P. (1999). Teaching, instruction, and technology. In A.C. Ornstein & L.S. Behar-Horenstein (Eds.), Contemporary issues in curriculum (pp.252- 264). Boston: Allyn and Bacon.

Hunter, A. E. (2012). *The effects of computer assisted instruction and structured curriculum on struggling mathematics students*. UMI dissertation publishing, Proquest LLC.

Kale, U., & Goh, D. (2011). Teachers' experiences and attitudes in engaging web 2.0 emerging technologies for project-based learning. In M. Koehler & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 3268-3273). Chesapeake, VA: AACE.

Kaufman, R., Guerra, I., & Platt, W.A. (2006). *Practical evaluation for educators: Finding what works and what doesn't.* Thousand Oaks, CA: Corwin Press.

Ke, F. (2008). Computer games application within alternative classroom goal structures: cognitive, metacognitive, and affective evaluation. *Education Technology Research and Development*, *56*, 539–556. Retrieved from EBSCOhost database.

Keengwe, J., Hussein, F., & Schnellert, G. (2012). Computer assisted instruction and student performance: A case study. *Proceedings of Society for Information Technology & Teacher Education International Conference 2012* (pp. 2875-2878). Chesapeake, VA: AACE.

Kinshuk. (2012). Guest editorial: personalized learning. *Educational Technology Research & Development, 60*(4), 561-562. Doi: 10.1007/s11423-012-9248-3

Kuhn, M., & Dempsey, K. (2011). End the math wars. *Learning & leading with technology, 39*(3), 18-21. Retrieved from EBSCOhost database.

Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research, 86*(1), 42-78. Retrieved from EBSCOhost database.

Ku, H. Y., Harter, C. A., Liu, P. L., Thompson, L., & Cheng, Y. C. (2007). The effects of individually personalized computer-based instructional program on solving mathematics problems. *Computers in Human Behavior*, *23*(3), 1195-1210. Retrieved from EBSCOhost database.

Lauria, J. (2010). Differentiation through learning-style responsive strategies. *Kappa Delta Pi Record, 47*(1), 24-29. Retrieved from EBSCOhost database.

Lee, M. H., & Tsai, C. C. (2010). Exploring teachers' perceived self-efficacy and technological pedagogical content knowledge with respect to educational use of the world wide web. *Instructional Science*, *38*, 1-21. Retrieved from EBSCOhost database.

Lewis, R. (2010). *The effectiveness of computer-assisted instruction on student math achievement* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Full Text database. (UMI No. 3441943)

Light, D., & Pierson, E. (2014). Increasing student engagement in math: The use of khan academy in chilean classrooms. *International Journal of Education and Development using ICT, 10*(2), 103-119. Retrieved from EBSCOhost database.

Liu, M., & Bera, S. (2005). An analysis of cognitive tool use patterns in a hypermedia learning environment. *Educational Technology Research and Development, 53*(1), 5-21. Retrieved from EBSCOhost database.

Liu, S. H., & Wu, C.F. (2011). Elementary school student perceptions regarding constructivist technology integration after teachers' implementation over a longer period. *Proceedings of World Conference on E-Learning in Corporate,* *Government, Healthcare, and Higher Education 2011* (pp. 1444-1449). Chesapeake, VA: AACE.

Logan, B. (2011). Examining differentiated instruction: Teachers respond. *Research in Higher Education Journal*, *13*(1), 1-14. Retrieved from EBSCOhost database.

Maloy, R. W., Razzaq, L., & Edwards, S. A. (2014). Learning by choosing: fourth graders use of an online multimedia tutoring system for math problem solving. *Journal of Interactive Learning Research, 25*(1), 51-64. Chesapeake, VA: AACE.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*. Thousand Oaks, Calif: SAGE Publications.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge, MA: Cambridge University Press.

McFarlane, C. (2013). Ipads and their potential to revolutionize learning. *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2013* (pp. 1690-1695). Chesapeake, VA: AACE.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco, CA: Jossey-Bass

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Moore-Hayes, C. (2011). Technology integration preparedness and its influence on teacher self-efficacy. *Canadian Journal of Learning* and Technology, *37*(3), 2-15. Retrieved from EBSCOhost database.

Morrison, Z. J., Gregory, D., & Thibodeau, S. (2012). "Thanks for using me". An exploration of exit strategy in qualitative research. *International Journal of Qualitative Methods*, *11*(4), 416-427. Retrieved from http://ejournals.library.ualberta.ca/index.php/IJQM/article/view/10572.

Musti-Rao, S., & Plati, E. (2015). Comparing two classwide interventions: Implications of using technology for increasing multiplication fact fluency. *Journal of Behavior Education, 24,* 418-437. doi: 10.1007/s10864-015-9228

Ojalainen, J., & Pauna, M. (2013). Web-based mathematics exercises and their effect on students' achievement and confidence. *Proceedings of Society for Information Technology & Teacher Education International Conference 2013* (pp. 2335-2340). Chesapeake, VA: AACE.

Patterson, J., Conolly, M., & Ritter, S. (2009). Restructuring the inclusion classroom to facilitate DI. *Middle School Journal, 41*(1), 46-52. Retrieved from EBSCOhost database.

Patton, M. Q. (2009). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Peshek, S. (2012). Assessment and grading in a differentiated mathematics classroom. *Ohio Journal of School Mathematics*, *65*, 45-50. Retrieved from EBSCOhost database.

Prain, V., Cox, P., Deed, C., Dorman, J., Edwards, D., Farrelly, C., &…Yager, Z. (2013). Personalized learing: Lessons to be learnt. *British Educational Research Journal, 39*(4), 654-676. Retrieved from EBSCOhost database.

Proscia, M., Ulrich, F., Nicolino, P., & Morote, E.S. (2010). Teachers' attitudes toward the use of computers in the classroom and differentiated instruction and instructional technology. *Society for Information Technology & Teacher Education International Conference 2010* (pp. 3340-3347). Toronto, Canada: AACE.

Ritzhaupt, A., Higgins, H., & Allred, B. (2011). Effects of modern educational game play on attitudes towards mathematics, mathematics self-efficacy, and mathematics achievement. *Journal of Interactive Learning Research, 22*(2), 277-297. Chesapeake, VA: AACE.

Roblyer, M. D., & Doering, A. (2009). *Integrating education technology into teaching*. Needham Heights, MA: Allyn & Bacon.

Rosen, Y., & Livshits, D. (2011). Does digital teaching platform make a difference? *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 3700-3711). Chesapeake, VA: AACE.

Sad, N.S., & Ozhan, U. (2012). Honeymoon with iwbs: A qualitative insight in primary students' views on instruction with interactive whiteboard. *Computers and Education, 59*(4), 1184-1191. doi: 10.1016/j.compedu.2012.05.010

Schoppek, W., & Tulis, M. (2010). Enhancing arithmetic and word-problem solving skills efficiently by individualized computer-assisted practice. *The Journal of Educational Research*, *103*(4), 239-252. Retrieved from EBSCOhost database.

Schrader, C., & Bastiaens, T. (2012). Educational computer games and learning: The relationship between design, cognitive load, emotions and outcomes. *Journal of Interactive Learning Research, 23*(3), 251-271. Retrieved from EBSCOhost database.

Scott, B., Rockman, S., Kuusinen, C., & Bass, K. (2011). Evaluating the effectiveness of the time to know program. Paper presented at the American Educational Research Association Annual Meeting, New Orleans.

Shamir, H., Morris, A., & Johnson, E. (2014). Can young children learn math through computer assisted instruction: An evaluation of the early math & science program. *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2014* (pp. 2415-2422). Chesapeake, VA: AACE.

Shaw, C., Brady, L. M., & Davey, C. (2011). Guidelines for research with children and young people. *London: National Children's Bureau Research Centre.*

Skinner, C. H., & Daly, E. J. (2010). Improving generalization of academic skills: Commentary on the special series. *Journal of Behavioral Education*, *19*, 106–115. Retrieved from EBSCOhost database.

Slaten, M., Rice, M., & Emfinger, K. (2013). Using technology as an intervention tool for struggling kindergarteners. *Proceedings of Society for Information Technology & Teacher Education International Conference 2013* (pp. 4420-4423). Chesapeake, VA: AACE.

Smith, H. J., Higgins, S., Wall, K. & Miller, J. (2005). Interactive whiteboards: Boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*, *21*(4), 91-101. Retrieved from EBSCOhost database.

Spector, J. M., Merrill, M. D., Merrienboer, J. V., & Driscoll, M. P. (2008). *Handbook of research on educational communications and technology* (3rd ed.). New York: Lawrence Erlbaum Associates.

Spradlin, K., & Ackerman, B. (2010). The effectiveness of computer-assisted instruction in developmental mathematics. *Journal of Developmental Education, 34*(2), 12-14. Retrieved from EBSCOhost database.

Stanford, P., Flice, H., & Crowe, M. W. (2010). Differentiating with technology. *Teaching Exceptional Children Plus, 6*(4), 2-9. Retrieved from http://escholarship.bc.edu/education/tecplus/vol6/iss4/art2

Stavroula, V. A., Mary, K., & Leonidas, K. (2011, January). Investigating the impact of differentiated instruction in mixed ability classrooms: Its impact on the quality and equity dimensions of education effectiveness. Paper presented at the International Congress for School Effectiveness and Improvement. Retrieved from http://www.icsei.net/icsei2011/Full%20Papers/0155.pdf

The Nation's Report Card: A first look: 2013 mathematics and reading (NCES 2014-451). Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

Thomson, D. L. (2010). Beyond the classroom walls: Teachers' and students' perspectives on how online learning can meet the needs of gifted students. *Journal of Advanced Academics, 21*(4), 662-712. Retrieved from EBSCOhost database.

Tobin, R., & Tippett, C. D. (2014). Possibilities and potential barriers: Learning to plan for differentiated instruction in elementary science. *International Journal of Science and Mathematics Education, 12*(2), 423-443. Retrieved from EBSCOhost database.

Tomlinson, C. A., & Allan, S. D. (2000). *Leadership or differentiating schools and classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

Tomlinson, C. (2005). Differentiating instruction: Why bother? *Middle Ground, 9*(1), 12-15. Retrieved from EBSCOhost database.

Tomlinson, C. A. (2009). Intersections between differentiation and literacy instruction: Shared principles worth sharing. *New England Reading Association Journal, 45*(1), 28-33. Retrieved from EBSCOhost database.

Tomlinson, C., & Imbeau, M. B. (2012). Common sticking points about differentiation. *School Administrator, 69*(5), 18-22. Retrieved from EBSCOhost database.

Tomlinson, C. A. (2013, June). Defensible differentiation: Why, what, and how. Slide presentation at the American School in London Learning Institute, London, England. Retrieved from http://www.caroltomlinson.com/Presentations/Tomlinson%20ASL%20Institute%206-13%20V2.pdf

Townsend, M. (2011). It's in the way that you use it, maybe. *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 1715-1720). Chesapeake, VA: AACE.

Treadwell, J. (2010). *The Impact of Discovery Learning in Writing Instruction on Fifth-Grade Student Achievement* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Full Text database. (UMI No. 3396813)

Trinter, C. P. (2015). Designing differentiated mathematics games: Discarding the one-size-fits- all approach to educational game play. *Gifted Child Today, 38*(2), 88-94. doi:10.1177/1076217514568560.

Tsai, I. C., Galyen, K., Xie, X., & Laffey, J. (2010). Using activity theory to examine social interaction of online learning. *Proceedings of World Conference on Educational Media and Technology 2010* (pp. 1202-1211). Toronto, Canada: AACE.

Tsai, F. H., Yu, K. C., & Hsiao, H. S. (2012). Exploring the factors influencing learning effectiveness in digital game-based learning. *Educational Technology & Society*, *15*(3), 240–250. Retrieved from EBSCOhost database.

Turner, J., & Smith, M. (2012). *A mathematics problem: How to help students achieve success in mathematics through college and beyond*. Durham: MetaMetrics, Inc.

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist, 46*(4), 197-221. doi:10.1080/00461520.2011.611369

Verenikina, I. (2010). Vygotsky in twenty-first-century research. *Proceedings of World Conference on Educational Media and Technology 2010* (pp. 16-25). Toronto, Canada: AACE.

Vigdor, J. (2013). Solving America's math problem. *Education Next*, *13*(1), 2-24. Retrieved January 25, 2015 from http://educationnext.org/solving-america%E2%80%99s-math-problem

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wright, V. H., & Wilson, E. K. (2011). Teachers' use of technology: Lessons learned from the teacher education program to the classroom. *SRATE Journal*, *20*(2), 48-60. Retrieved from EBSCOhost database.

Yildiz, Z., & Aktas, M. (2015). The effect of computer-assisted instruction on achievement and attitude of primary school students. *International Online Journal of Educational Sciences,* 7(1), 97-109. Retrieved from EBSCOhost database.

Yin, R. K. (2014). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Appendix A: Teacher Invitation Letter

January 28, 2016

Hello, teacher name will go here

My name is Christopher Garrett Cannon and I am a doctoral candidate in educational technology at Walden University. I am conducting a research study as part of the requirements of my degree in educational technology, and I would like to invite you to participate in this study.

I am interested in exploring the perceptions of teachers and students using computer-assisted instructional software to differentiate instruction within two fourth grade mathematics classrooms. To accomplish this purpose, I will describe how teachers and students use MobyMax software to help students improve their learning in mathematics.

I am inviting you to participate in this research because you currently teach a fourth grade mathematics class that uses MobyMax software. Dr. Andrews, principal of Holly Hills Elementary, provided your contact information.

Please read the attached teacher consent form carefully because the procedures for participation are explained. If you have any questions about the study, you may contact me at christopher.cannon@waldenu.edu. I have also included a copy of the classroom observation instrument.

If you would like to participate in this study, send a reply e-mail to me directly at christopher.cannon@waldenu.edu stating the words, “I consent.”

Respectfully,
Christopher Garrett Cannon
Walden University
Ph.D. Doctoral Candidate

Appendix B: Classroom Observation Instrument

DIFFERENTIATED INSTRUCTION
CLASSROOM OBSERVATION FORM

School: ____________________ **Grade:** _____ **Subject:** __________ **Period/Time:** _____

Teacher: ____________________ **Date:** _____/_____/_____ **Observer:** _________________

I. CONTEXT/GOAL SETTING	Strong	Some	None
1) Established clear **learning goals** (knowledge, understanding, skills).			
2) Linked new subject matter to **prior learning** and/or **experience**.			
3) Most students appear aware of and **understand** the learning goals.			
4) Provided **rubrics or other guides** to focus students on goals.			
5) **Closed the class** with a focus on goals/meaning of lesson.			
Comments:			

II. STUDENT ASSESSMENT	Strong	Some	None
1) Implemented & used results of **pre-assessment** to adjust the lesson.			
2) Implemented assessment **during lesson** to gauge understanding.			
3) Attended to **student questions/comments** during lesson.			
4) Implemented assessment at **end of lesson** to gauge student learning.			
Comments:			

III. ATTENTION TO INDIVIDUALS/BUILDING COMMUNITY	Strong	Some	None
1) **Talked** with students as they entered/exited class.			
2) Connected with **individual students** during class.			
3) Helped develop awareness of one another's **strengths/contributions**.			
4) Involved whole class in **sharing/planning/evaluating**.			
Comments:			

IV. INSTRUCTIONAL PRACTICES AND CLASSROOM ROUTINES	Strong	Some	None
1) Varied **student groupings**: individual; pairs; small groups.			
2) Used **multiple modes of instruction**, with emphasis on active learning.			
3) Made **flexible use** of classroom space, time, materials.			
4) Communicated **clear directions** for multiple tasks.			
5) Provided effective **rules/routines** that supported individual needs.			
6) Displayed effective classroom **leadership/management**.			
Comments:			

V. POSITIVE, SUPPORTIVE LEARNING ENVIRONMENT	Strong	Some	None
1) Demonstrated **respectful behavior** toward students.			
2) Demonstrated **sensitivity** to different cultures/ethnicities.			
3) Acknowledged/celebrated student **strengths/successes**.			
4) Active participation by a **broad range** of students.			
5) Students **comfortable** asking questions/requesting assistance.			
6) Emphasis on **competition against self**, not other students.			
Comments:			

VI. QUALITY CURRICULUM	Strong	Some	None
1) Lesson targeted one or more State **learning standards**.			
2) Lesson focused on **important ideas**, issues, or problems.			
3) Tasks emphasized **thought/meaning vs. drill & practice**.			
Comments:			

VII. PREPARATION FOR & RESPONSE TO LEARNER NEEDS	Strong	Some	None
1) Showed **proactive preparation** for a variety of student needs.			
2) Attended appropriately to students who **struggle with learning** (LD; ELL; reading; etc.).			
3) Attended appropriately to students with **physical/behavioral challenges**.			
4) Attended appropriately to **advanced** students.			
Comments:			

VIII. EVIDENCE OF DIFFERENTIATION	Strong	Some	None
1) **Content:** e.g. materials of varied readability and/or interest; multiple ways to access ideas/information; etc.			
2) **Process:** e.g., tiering; contracts; compacting; readiness-based small-group instruction; different homework; choices about how to work (alone, pair, small group); tasks in multiple modes; variety of scaffolding; etc..			
3) **Products:** e.g., product assignments with multiple modes of expression; with choices about how to work (alone, pairs, small group); opportunity to connect learning with individual interests; variety of assessment tasks; variety of scaffolding; etc.			
Comments (example of differentiation based on readiness, interest, & learning profile):			

1a. Did the lesson meet the needs of learners at **all achievement levels**? (✓ one only)

☐ (1) Yes ☐ (2) No

1b. If No, toward what **type/s of student** did the lesson seem geared? (✓ all that apply)

☐ (1) Below basic ☐ (2) Basic ☐ (3) Proficient ☐ (4) Advanced

Examples:

1.15.06/Classroom Observation Form-DI—Used with permission
Acknowledgements: This instrument was created with Carol Tomlinson by Strategic Research, LLC as part of a program evaluation contracted by the Richland 2 School District in Columbia, South Carolina. Inquiries should be addressed to StrategicRsrch@aol.com.

Strategic Research

Appendix C: Permission to use the Differentiated Instruction Observation Instrument

Header Gmail text

Delivered-To: christopher.cannon@waldenu.edu
Received: by 10.60.46.3 with SMTP id r3csp716925oem;
Fri, 8 Jan 2016 11:54:26 -0800 (PST)
X-Received: by 10.140.27.202 with SMTP id 68mr80866199qgx.4.1452282866128;
Fri, 08 Jan 2016 11:54:26 -0800 (PST)
Return-Path: <cat3y@virginia.edu>
Received: from washington1.eservices.virginia.edu
(washington1.eservices.Virginia.EDU. [128.143.2.18])
by mx.google.com with ESMTPS id q189si70026606qhq.47.2016.01.08.11.54.25
for <christopher.cannon@waldenu.edu>
(version=TLS1 cipher=ECDHE-RSA-AES128-SHA bits=128/128);
Fri, 08 Jan 2016 11:54:26 -0800 (PST)
Received-SPF: pass (google.com: best guess record for domain of cat3y@virginia.edu designates 128.143.2.18 as permitted sender) client-ip=128.143.2.18;
Authentication-Results: mx.google.com;
spf=pass (google.com: best guess record for domain of cat3y@virginia.edu designates 128.143.2.18 as permitted sender) smtp.mailfrom=cat3y@virginia.edu
Received: from GRANT1.eservices.virginia.edu ([fe80::991f:95f0:f798:60a3]) by washington1.eservices.virginia.edu ([::1]) with mapi id 14.02.0342.003; Fri, 8 Jan 2016 14:54:25 -0500
From: "Tomlinson, Carol Ann (cat3y)" <cat3y@virginia.edu>
To: Christopher Cannon <christopher.cannon@waldenu.edu>
Subject: RE: Differentiated Instruction Classroom Observation Instrument
Thread-Topic: Differentiated Instruction Classroom Observation Instrument
Thread-Index: AQHRRv+KG+JcQpq+b0602hygpI+h6p7yDpeA
Date: Fri, 8 Jan 2016 19:54:24 +0000

Receipt of Correspondence Requesting Permission to Use Observation Instrument

From: cat3y@virginia.edu Tomlinson, Carol Ann (cat3y)
To:
Date: Fri, 8 Jan 2016 14:54:24 -0500
Subject: RE: Differentiated Instruction Classroom Observation Instrument

Hi Christopher-

It’s fine for you to use the survey you attached to your e-mail in data gathering for your dissertation.

Good luck with your work.

Carol

From: Christopher Cannon [mailto:christopher.cannon@waldenu.edu]
Sent: Monday, January 04, 2016 9:53 AM
To: Tomlinson, Carol Ann (cat3y)
Subject: Differentiated Instruction Classroom Observation Instrument

To whom it may concern,

My name is Christopher Garrett Cannon. I am a PhD candidate at Walden University. I am in the process of finalizing my dissertation proposal. I aim to conduct a qualitative multiple case study to explore the Teacher and Student Perceptions of Computer Assisted Instructional Software to Differentiate Instruction.

I am writing this e-mail to request permission to use the differentiated instruction classroom observation instrument created with Strategic Research, LLC. I have attached the form to this e-mail. Thank you for your time!
Christopher Garrett Cannon
PhD Education-Educational Technology
Walden University

Appendix D: Introductory Teacher Interview Guide

<u>Introductory questions to get to know the teacher.</u>

1. How many years have you been teaching?
2. What grade and subject areas do you teach?
3. How many years have you used MobyMax as an instructional resource?
4. How do you define differentiated instruction?
5. How do you define computer-assisted instruction?

<u>Interview questions based on constructivism theory.</u>

6. Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences?
7. How do you and/or the students decide how to use MobyMax, and how much to use it?
8. Do you feel that you are able to use MobyMax to incorporate individual student interests? If yes, please explain how. If no, please explain why not.
9. What are the positive aspects to using MobyMax?
10. What data do you actually get from reports derived from MobyMax? How often?
11. How do you use the data when deciding what to do next?
12. How satisfied are you with the data you actually get from MobyMax, given how you use it in your classroom?
13. What are the negative aspects of using MobyMax?
14. How do you document the use of MobyMax in your lesson plans?

15. What are your recommendations for using MobyMax to remediate student learning?
16. What are your recommendations for using MobyMax to enrich student learning?

Appendix E: Follow-up Teacher Interview Guide

1. Did all students use MobyMax for the same amount of time, in the same way during the year-end review unit? If not, what were the differences?
2. How did you and/or the students decide how to use MobyMax, and how much to use MobyMax during the year-end review unit?
3. How did you use MobyMax to meet the individual needs of all students during the year-end review unit? Were your efforts successful? If yes, please explain how. If no, please explain why not?
4. Do you feel that you were able to use MobyMax to incorporate individual student interests during the year-end review unit? If yes, please explain how. If no, please explain why not.
5. What were the positive aspects to using MobyMax during the year-end review unit?
6. What issues did you encounter in implementing MobyMax and integrating it into your teaching plans during the year-end review unit? Did these issues cost you extra time or effort?
7. Was it worth the time and effort to implement MobyMax into the year-end review unit? If yes, please explain how. If no, please explain why not.
8. How did you document the use of MobyMax in your lesson plans during the year-end review unit?
9. What are your recommendations for using MobyMax to remediate student learning during a year-end review unit?

10. What are your recommendations for using MobyMax to enrich student learning during a year-end review unit?
11. Please share any other thoughts/comments you have in regards to student behaviors and engagement while using MobyMax during the year-end review unit.

Appendix F: Introductory Student Focus Group Interview Guide

1. How many school years have you been using MobyMax? How many times per week are you using MobyMax?
2. Would you like to use MobyMax more or less than the amount of time you are currently using it? Please explain your choice?
3. Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences?
4. Are students allowed to decide how to use MobyMax, and how much to use it? If yes, please explain how. If no, please explain why not.
5. How often does your teacher stop to talk to you while you are using MobyMax?
6. What are the specific parts of MobyMax that you like?
7. What are the specific parts of MobyMax that you do not like?
8. What are the ways your teacher could improve the way he/she uses MobyMax in your classroom?

Appendix G: Follow-up Student Focus Group Interview Guide

1. During the year-end review unit, were you allowed to decide how to use MobyMax, and how much to use it?
2. Would you like to use MobyMax more or less than the amount of time you used it during the year-end review unit? Please explain your choice.
3. How often did your teacher stop to talk to you while you were using MobyMax during the year-end review unit?
4. What are some specific parts of MobyMax that you enjoyed during the year-end review unit?
5. What are some specific parts of MobyMax that you did not like during the year-end review unit?
6. What are some ways your teacher could improve the way he/she uses MobyMax to teach the year-end review unit?
7. Please share any other thoughts/comments you have in regards to using MobyMax during the year-end review unit.

Appendix H: Table of Alignment for Research and Interview Questions

Alignment of Research and Interview Questions

Research Question	Introductory and Follow-up Teacher Interview Questions	Introductory and Follow-up Student Focus Group Interview Questions
Central RQ: How do teachers use computer-assisted instructional software in two fourth grade mathematics classrooms to differentiate instruction?	**Introductory Teacher Interview Guide** 1.How many years have you been teaching? 2.What grade and subject areas do you teach? 3.How many years have you used MobyMax as an instructional resource? 4.How do you define differentiated instruction? 5.How do you define computer-assisted instruction? 6.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences? 7.How do you and/or the students decide how to use MobyMax, and how much to use it? 8.Do you feel that you are able to use MobyMax to incorporate individual student interests? If yes, please explain how. If no, please explain why not. 9.What are the positive aspects to using MobyMax? 10.What data do you actually get from reports derived from MobyMax? How often? 11.How do you use the data when deciding what to do	**Introductory Student Focus Group Interview Guide** 1.How many school years have you been using MobyMax? How many times per week are you using MobyMax? 2.Would you like to use MobyMax more or less than the amount of time you are currently using it? Please explain your choice? 3.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences? 4.Are students allowed to decide how to use MobyMax, and how much to use it? If yes, please explain how. If no, please explain why not. 5.How often does your teacher stop to talk to you while you are using MobyMax? 6.What are the specific parts of MobyMax that you like? 7.What are the specific parts of MobyMax that you do not like? 8.What are the ways your teacher could improve the way he/she uses MobyMax

next?
12.How satisfied are you with the data you actually get from MobyMax, given how you use it in your classroom?
13.What are the negative aspects of using MobyMax?
14.How do you document the use of MobyMax in your lesson plans?
15.What are your recommendations for using MobyMax to remediate student learning?
16.What are your recommendations for using MobyMax to enrich student learning?

Follow-up Teacher Interview Guide

1.Did all students use MobyMax for the same amount of time, in the same way during the year-end review unit? If not, what were the differences?
2.How did you and/or the students decide how to use MobyMax, and how much to use MobyMax during the year-end review unit?
3.How did you use MobyMax to meet the individual needs of all students during the year-end review unit? Were your efforts successful? If yes, please explain how. If no, please explain why not?
4.Do you feel that you were able to use MobyMax to incorporate individual student interests during the year-end in your classroom?

Follow-up Student Focus Group Interview Guide

1.During the year-end review unit, were you allowed to decide how to use MobyMax, and how much to use it?
2.Would you like to use MobyMax more or less than the amount of time you used it during the year-end review unit? Please explain your choice.
3.How often did your teacher stop to talk to you while you were using MobyMax during the year-end review unit?
4.What are some specific parts of MobyMax that you enjoyed during the year-end review unit?
5.What are some specific parts of MobyMax that you did not like during the year-end review unit?
6.What are some ways your teacher could improve the way he/she uses MobyMax to teach the year-end review unit?
7.Please share any other thoughts/comments you have in regards to using MobyMax during the year-end review unit.

review unit? If yes, please explain how. If no, please explain why not.
5.What were the positive aspects to using MobyMax during the year-end review unit?
6.What issues did you encounter in implementing MobyMax and integrating it into your teaching plans during the year-end review unit? Did these issues cost you extra time or effort?
7.Was it worth the time and effort to implement MobyMax into the year-end review unit? If yes, please explain how. If no, please explain why not.
8.How did you document the use of MobyMax in your lesson plans during the year-end review unit?
9.What are your recommendations for using MobyMax to remediate student learning during a year-end review unit?
10.What are your recommendations for using MobyMax to enrich student learning during a year-end review unit?
11.Please share any other thoughts/comments you have in regards to student behaviors and engagement while using MobyMax during the year-end review unit.

RQ1: How do teachers perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade mathematics classrooms?	**Introductory Teacher Interview Guide** 1.How many years have you been teaching? 2.What grade and subject areas do you teach? 3.How many years have you used MobyMax as an instructional resource? 4.How do you define differentiated instruction? 5.How do you define computer-assisted instruction? 6.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences? 7.How do you and/or the students decide how to use MobyMax, and how much to use it? 8.Do you feel that you are able to use MobyMax to incorporate individual student interests? If yes, please explain how. If no, please explain why not. 9.What are the positive aspects to using MobyMax? 10.What data do you actually get from reports derived from MobyMax? How often? 11.How do you use the data when deciding what to do next? 12.How satisfied are you with the data you actually get from MobyMax, given how you use it in your classroom? 13.What are the negative aspects of using MobyMax?

14.How do you document the use of MobyMax in your lesson plans?
15.What are your recommendations for using MobyMax to remediate student learning?
16.What are your recommendations for using MobyMax to enrich student learning?

Follow-up Teacher Interview Guide
1.Did all students use MobyMax for the same amount of time, in the same way during the year-end review? If not, what were the differences?
2.How did you and/or the students decide how to use MobyMax, and how much to use MobyMax during the year-end review unit?
3.How did you use MobyMax to meet the individual needs of all students during the year-end review unit? Were your efforts successful? If yes, please explain how. If no, please explain why not?
4.Do you feel that you were able to use MobyMax to incorporate individual student interests during the year-end review unit? If yes, please explain how. If no, please explain why not.
5.What were the positive aspects to using MobyMax during the year-end review unit?

	6.What issues did you encounter in implementing MobyMax and integrating it into your teaching plans during the year-end review unit? Did these issues cost you extra time or effort? 7.Was it worth the time and effort to implement MobyMax into the year-end review unit? If yes, please explain how. If no, please explain why not. 8.How did you document the use of MobyMax in your lesson plans during the year-end review unit? 9.What are your recommendations for using MobyMax to remediate student learning during a year-end review unit? 10.What are your recommendations for using MobyMax to enrich student learning during a year-end review? 11.Please share any other thoughts/comments you have in regards to student behaviors and engagement while using MobyMax during the year-end review unit.	
RQ2: How do students perceive the value of using computer-assisted instructional software as a differentiated instruction tool in two fourth grade		**Introductory Student Focus Group Interview Guide** 1.How many school years have you been using MobyMax? How many times per week are you using MobyMax? 2.Would you like to use

mathematics classrooms?

MobyMax more or less than the amount of time you are currently using it? Please explain your choice?

3.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences?

4.Are students allowed to decide how to use MobyMax, and how much to use it? If yes, please explain how. If no, please explain why not.

5.How often does your teacher stop to talk to you while you are using MobyMax?

6.What are the specific parts of MobyMax that you like?

7.What are the specific parts of MobyMax that you do not like?

8.What are the ways your teacher could improve the way he/she uses MobyMax in your classroom?

Follow-up Student Focus Group Interview Guide

1.During the year-end review unit, were you allowed to decide how to use MobyMax, and how much to use it?

2.Would you like to use MobyMax more or less than the amount of time you used it during the year-end review unit? Please explain your choice.

3.How often did your teacher

		stop to talk to you while you were using MobyMax during the year-end review unit? 4.What are some specific parts of MobyMax that you enjoyed during the year-end review unit? 5.What are some specific parts of MobyMax that you did not like during the year-end review unit? 6.What are some ways your teacher could improve the way he/she uses MobyMax to teach the year-end review unit? 7.Please share any other thoughts/comments you have in regards to using MobyMax during the year-end review unit.
RQ3: How does computer-assisted instructional software in two fourth grade mathematics classrooms provide differentiated instructional opportunities for students?	**Introductory Teacher Interview Guide** 1.How many years have you been teaching? 2.What grade and subject areas do you teach? 3.How many years have you used MobyMax as an instructional resource? 4.How do you define differentiated instruction? 5.How do you define computer-assisted instruction? 6.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences? 7.How do you and/or the students decide how to use MobyMax, and how much to	**Introductory Student Focus Group Interview Guide** 1.How many school years have you been using MobyMax? How many times per week are you using MobyMax? 2.Would you like to use MobyMax more or less than the amount of time you are currently using it? Please explain your choice? 3.Do all students use MobyMax for the same amount of time, in the same way? If not, what are the differences? 4.Are students allowed to decide how to use MobyMax, and how much to

use it?
8.Do you feel that you are able to use MobyMax to incorporate individual student interests? If yes, please explain how. If no, please explain why not.
9.What are the positive aspects to using MobyMax?
10.What data do you actually get from reports derived from MobyMax? How often?
11.How do you use the data when deciding what to do next?
12.How satisfied are you with the data you actually get from MobyMax, given how you use it in your classroom?
13.What are the negative aspects of using MobyMax?
14.How do you document the use of MobyMax in your lesson plans?
15.What are your recommendations for using MobyMax to remediate student learning?
16.What are your recommendations for using MobyMax to enrich student learning?

Follow-up Teacher Interview Guide
1.Did all students use MobyMax for the same amount of time, in the same way during the year-end review unit? If not, what were the differences?
2.How did you and/or the students decide how to use it? If yes, please explain how. If no, please explain why not.
5.How often does your teacher stop to talk to you while you are using MobyMax?
6.What are the specific parts of MobyMax that you like?
7.What are the specific parts of MobyMax that you do not like?
8.What are the ways your teacher could improve the way he/she uses MobyMax in your classroom?

Follow-up Student Focus Group Interview Guide
1.During the year-end review unit, were you allowed to decide how to use MobyMax, and how much to use it?
2.Would you like to use MobyMax more or less than the amount of time you used it during the year-end review unit? Please explain your choice.
3.How often did your teacher stop to talk to you while you were using MobyMax during the year-end review unit?
4.What are some specific parts of MobyMax that you enjoyed during the year-end review unit?
5.What are some specific parts of MobyMax that you did not like during the year-end review unit?
6.What are some ways your

	MobyMax, and how much to use MobyMax during the year-end review unit? 3.How did you use MobyMax to meet the individual needs of all students during the year-end review unit? Were your efforts successful? If yes, please explain how. If no, please explain why not? 4.Do you feel that you were able to use MobyMax to incorporate individual student interests during the year-end review unit? If yes, please explain how. If no, please explain why not. 5.What were the positive aspects to using MobyMax during the year-end review unit? 6.What issues did you encounter in implementing MobyMax and integrating it into your teaching plans during the year-end review unit? Did these issues cost you extra time or effort? 7.Was it worth the time and effort to implement MobyMax into the year-end review unit? If yes, please explain how. If no, please explain why not. 8.How did you document the use of MobyMax in your lesson plans during the year-end review unit? 9.What are your recommendations for using MobyMax to remediate student learning during a year-end review unit?	teacher could improve the way he/she uses MobyMax to teach the year-end review unit? 7.Please share any other thoughts/comments you have in regards to using MobyMax during the year-end review unit.

10. What are your recommendations for using MobyMax to enrich student learning during a year-end review unit?
11. Please share any other thoughts/comments you have in regards to student behaviors and engagement while using MobyMax during the year-end review unit.

Appendix I: District Letter of Cooperation

Christopher Garrett Cannon
Address line 1
City, State, Zip code
Contact phone number
christopher.cannon@waldenu.edu

January 24, 2016

Dear Mr. Cannon,

Based on my review of your research proposal, I give permission for you to conduct the study titled *Teacher and Student Perceptions of Computer Assisted Instructional Software to Differentiate Instruction* in the Hickory County School District. As part of this study, I authorize you to (a) select a fourth grade mathematics teacher and six fourth grade students from that class as participants, (b) collect data from introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and teacher lesson plans. Individuals' participation will be voluntary and at their own discretion. Additionally, I confirm that MobyMax is a computer-assisted instructional resource currently implemented and utilized in daily classroom instruction and remedial services as part of the Hickory County School District mathematics curriculum.

We understand that our organization's responsibilities include access to a private room within the school with a door that can be closed for privacy purposes to conduct the teacher and student focus group interviews after regular school hours. We reserve the right to withdraw from the study at any time if our circumstances change.

The teacher and students will be responsible for complying with our site's research policies and requirements.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,
Mrs. Geiger, Associate Superintendent
Hickory County Schools

Address line 1
City, State, Zip code
Phone number

Printed Name of Associate Superintendent	______________________________
Date of Consent	______________________________
Associate Superintendent’s Signature	______________________________
Researcher’s Signature	______________________________

Appendix J: School Letter of Cooperation

Christopher Garrett Cannon
Address line 1
City, State, Zip code
Contact phone number
christopher.cannon@waldenu.edu

January 24, 2016

Dear Mr. Cannon,

Based on my review of your research proposal, I give permission for you to conduct the study titled *Teacher and Student Perceptions of Computer Assisted Instructional Software to Differentiate Instruction* at Holly Hills Elementary School. As part of this study, I authorize you to (a) select a fourth grade mathematics teacher and six fourth grade students from that class as participants, (b) collect data from introductory and follow-up teacher interviews, introductory and follow-up student focus group interviews, classroom observations, and teacher lesson plans. Individuals' participation will be voluntary and at their own discretion. Additionally, I confirm that MobyMax is a computer assisted instructional resource currently implemented and utilized in daily classroom instruction and remedial services as part of the Hickory County School District mathematics curriculum.

We understand that our organization's responsibilities include access to a private room within the school with a door that can be closed for privacy purposes to conduct the teacher and student focus group interviews after regular school hours. We reserve the right to withdraw from the study at any time if our circumstances change.

The teacher and students will be responsible for complying with our site's research policies and requirements.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the student's supervising faculty/staff without permission from the Walden University IRB.

Sincerely,

Dr. Andrews, Principal
Holly Hills Elementary School

Address line 1
City, State, Zip code
Phone number

Printed Name of Principal ________________________________

Date of Consent ________________________________

Principal’s Signature ________________________________

Researcher’s Signature ________________________________

Appendix K: Teacher Follow-up Letter

February 13, 2016

Hello, teacher name will go here

This is a follow-up letter to my original letter of invitation dated____________. I am inviting you to participate in this research because you currently teach a fourth grade mathematics class that uses MobyMax software. Dr. Andrews, principal of Holly Hills Elementary, provided your contact information.

This study is voluntary. Everyone will respect your decision of whether or not you choose to be in the study. No one at Hickory County Board of Education or Holly Hills Elementary will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind later. You may stop at any time.

Please read the attached teacher consent form carefully because the procedures for participation are explained. If you have any questions about the study, you may contact me at christopher.cannon@waldenu.edu. I have also included a copy of the classroom observation instrument.

If you would like to participate in this study, send a reply e-mail to me directly at christopher.cannon@waldenu.edu stating the words, "I consent."

Respectfully,
Christopher Garrett Cannon
Walden University
PhD Doctoral Candidate