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DOES MATHLETICS, A SUPPLEMENTARY DIGITAL MATH TOOL, IMPROVE STUDENT LEARNING AND TEACHING METHODS AT THREE PRIVATE CATHOLIC SCHOOLS IN FLORIDA? – A MIXED METHODS STUDY

By

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A DISSERTATION IN PRACTICE

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Abstract

Improving mathematical student performance in K-12 education has been a focus in the U.S. Students in the U.S. score lower on standardized math assessments than students in other countries. Preparing students for a successful future in a global society requires schools to integrate effective digital technologies in math classroom curricula. Determining whether supplemental digital tools impact the math classroom is challenging. To address these concerns, a convergent parallel mixed methods study examined the relationship of a supplemental digital math tool, *Mathletics*™, and Iowa Test of Basic Skills (ITBS)™ (Riverside Publishing, 2008) standardized test scores between 6th grade students. The study also explored the perceived impact of a supplemental digital math tool, *Mathletics*™, on student learning and teaching methods from faculty at III private, Catholic schools in Florida. Mixed methods data analysis revealed no statistically significant difference on standardized test scores for the *math* sections and a statistically significant difference on standardized test scores for the *computation* sections of the Iowa Test of Basic Skills (ITBS)™ (Riverside Publishing, 2008) standardized test scores. Faculty perceptions also indicated *Mathletics*™ was a benefit on student learning and teaching methods in the following ways; motivated and engaged the learner; was an effective supplementary digital tool for extended practice; aligned with core curriculum and math standards; provided ways for faculty to differentiate learning, individualize learning, and provide instant feedback. The study also revealed faculty concerns with Internet and technology issues, availability of computers and tablets concerns, lack of reporting tools and data to inform academic instruction, and the need for teacher professional development. The researcher proposes

four design frameworks to aid educational leaders and faculty in resolving the faculty concerns in this study that benefit student learning and teaching methods in the 6^{th} grade math classroom. Finally, the researcher concludes the study with recommendations for future research.

Keywords: Mathematics education, teacher professional development, standardized assessments, supplemental digital tools, educational technology

Dedication

This dissertation is dedicated to my loving and supportive husband, my two joyous and charming sons, and my caring and devoted parents.

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CHAPTER ONE: INTRODUCTION

Background of the Problem

Improving mathematical performance in K-12 environments has been a focus for educational leaders, teachers, and educational stakeholders. In fact, the United States adopted the Common Core Standards in an attempt to improve the way students learn mathematical concepts (Common Core Standards Initiative, n.d.). Former President Barack Obama's 2015 budget for K-12 education includes a funding plan to improve student learning and teaching strategies by incorporating innovative technologies in order to better prepare students for the workforce (U.S. Department of Education, 2015). Despite the initiatives to improve school standards, U.S. K-12 schools are not equipped with effective methods that foster the developments of math skills needed to prepare students for success in college and careers (McCormick & Lucas, 2011). As the landscape of K-12 education changes, school leaders become critical in leading teachers to become risk takers to change and in the decision process of how to meet student-learning needs in the math classroom (Eilers & D'Amico, 2012).

Implementing new supplementary digital math tools into the math classroom can help to improve student math learning (*Mathletics*, n.d.). Zhang & Gallegos (2015) found that math applications have the potential to help students who are struggling in math. Burns, Kanive, & DeGrande (2015) also note that struggling students benefited from computer-enhanced math intervention. However, proper exploration of the impact of these supplementary digital math tools are relative to improving student learning in the math classroom is needed, particularly in order to help school leaders in private, Catholic schools make appropriate changes to meet Federal, State, Province, and Diocese educational requirements. Zhang et al. (2015) recommends that further studies are needed to explore effective math applications to help students who are struggling in math. Moreover, Ernst & Clark (2012) note the importance of choosing the appropriate digital software in order to meet instructional learning outcomes and proper implementation can determine whether or not the tool is successful.

The purpose of the Creighton Dissertation in practice was to explain the relationship of a supplemental digital math tool, *Mathletics*™ on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores between 6th grade students at 3 private, Catholic schools in Florida. The study also explored the perceived impact of a supplemental digital math tool, *Mathletics*™, on student learning and teaching methods from faculty.

Mathletics™ is a Web 2.0 online supplemental digital math tool developed by 3P Learning (n.d.) for primary and secondary-aged learners. The online learning interface contains curriculum with practice activities that are adaptive to the individual student and can be accessed anywhere by using a login and passcode. *Mathletics*™ is also a social tool that is designed to promote collaboration by enabling the student to compete with other students around the world by answering math questions. Teachers and parents are able to view student progress through an online portal.

Constructivist learning theory and social cognitive theory was used to frame and explain the results of the research findings contained in this study. The constructivist learning theory and social cognitive theory can be used as a framework in the math classroom to improve teaching methods through the use of technological skill development (Garcia & Pacheco, 2012, Roblyer, 2016). The study also highlighted the use of transformational leadership to demonstrate an effective leadership model in order to incorporate supplementary digital math tools in private, Catholic schools. The aim of this Dissertation in Practice was to determine whether or not

Mathletics™ improved *student learning* and *teaching methods* in the 6th grade math classroom and created evidenced-based solutions for school leaders based on the research findings. Interpretations and conclusions from the data might also guide the integration of supplemental digital math tools to impact student math achievement into other math classroom environments.

Introduction and Statement of the Problem

Student assessment data from The Programme for International Student Assessment (PISA) (2015) and Trends in International Mathematics and Science Study (TIMSS) (2015) disclosed disturbing evidence of the state of math achievement in the United States. Students in the United States perform below average in math in comparison to other countries (Tucker & Darling-Hammond, 2014). The Programme for International Student Assessment (PISA) concluded in 2015 that students in the United States are below average in math compared to other countries. PISA (2012) also found that students in the United States struggle with mathematical computations. Other evidence indicates that TIMSS (2015) reported that 8th grade math students in the United States scored lower on math assessments in comparison to 8 other educational systems including Singapore, Hong Kong, Korea, and Japan. Progress in math achievement in the United States K-12 environments on the PISA and TIMSS confirms a lack of progress.

Evidence from standardized testing indicates that educational reform is needed. According to the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) (2015) scores, 6th grade students at a Catholic school in Florida scored below average in mathematics and computation compared to the Province (Florida and Georgia) and Diocese (Orlando). Moreover, additional research is needed to determine the impact of supplemental digital math tools toward the improvement of student learning outcomes and teaching methods. An executive summary by the National Center for Education Evaluation and Regional Assistance (2009) reported that supplemental mathematics software, Larson Pre-Algebra (Houghton-Mifflin, 2008) and Achieve Now (Plato Learning, 2008), utilized in the 6th grade math classroom did not show evidence of improvement on test scores in comparison to 6th grade math classrooms that did not use the same software.

Purpose of the Study

The purpose of this convergent parallel mixed methods study was to determine whether, *Mathletics*™, a supplemental digital math tool, improves student learning and teaching methods at three private, Catholic schools in Florida. In the study, a quantitative research question addressed the relationship of *Mathletics*™ and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores with 6th grade students at three private, Catholic schools in Florida. The educational leadership from the three private, Catholic schools in Florida provided the researcher with a summary of two iterations of 6th grade learners. One group of 6th graders at three Catholic schools in Florida used *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not used *Mathletics*™. For this study, the independent variables included Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for 6th grade math students (N=112) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (N=127) after the implementation of *Mathletics*™. Qualitative research was also conducted through a standardized qualitative interview protocol to explore the perceived impact of *Mathletics*™, a supplemental digital math tool, on student learning and teaching methods with faculty at the schools. This study used the parallel-databases variant approach, where the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores and the interview data was collected and analyzed independently and was mixed to develop an interpretation of the findings (Creswell & Plano Clark, 2011). This convergent parallel mixed methods approach will provide rich insight into the effectiveness and perceived strengths, and weaknesses of a supplemental digital math tool and provide a complete understanding of how the findings will impact future leadership decisions by classroom teachers, administrators, and other stakeholders concerning the implementation of digital math tools in the 6th grade math classroom.

Research Questions

This convergent parallel mixed methods study explored three research questions that addressed the (1) relationship of *Mathletics*™ and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores with 6th grade students at three private, Catholic schools in Florida and (2) faculty's perceived strengths, and weaknesses of *Mathletics*™ to student learning and teaching methods in the classroom. The statistical tests used for this study included both the independent samples t-test for the math section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) in which equal variances are assumed and the Welch's and Mann-Whitney test for the computation section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) in which unequal variances were assumed to help answer the quantitative research question. The study also used open-ended interview questions to help answer the qualitative research question. The study solicited 12 faculty members from three private, Catholic schools in Florida to explore the perceived impact of *Mathletics*™ on student learning and teaching methods at the schools. Data analysis procedures for this study included representing, interpreting, and validating the results to design an evidence-based solution to whether or not *Mathletics*™ improved *student learning* and *teaching methods* in the 6th grade math classroom (Creswell & Plano Clark, 2011).

Central Research Question

The central research question for this study was:

- Did the integration of interactive media such as *Mathletics*™ improve student learning and teaching methods in the 6th grade math classroom?

The Quantitative and Qualitative research questions for the study are:

Quantitative Research Question

For the quantitative phase of this study the guiding research question was:

- Did *Mathletics*™ improve student learning based on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores when comparing the achievement of 6th grade students who participated in *Mathletics*™ and students who did not participate in *Mathletics*™?

Qualitative Research Question

For the qualitative phase of this study the guiding research question was:

- What are faculty perceptions of whether or not *Mathletics*™ improves student learning and teaching methods?

Significance of the Study

The following section will provide an overview of why the study will benefit scholarly research and contribute to literature in math education, highlight the ways digital tools can enhance and improve educational practice in the 6th grade math classroom, and provide ways to integrate digital tools through school leadership to benefit pedagogy and public policy. This study will also explore the interdisciplinary nature of the research and how it explores the complex problem of choosing and implementing effective supplementary tools for pedagogy.

Zhang, Trussell, Gallegos, & Asam (2015) stated that elementary students have difficulties demonstrating proficiency with basic math concepts. A study conducted by the National Assessment of Educational Progress (2013) concluded that 26% of eight grade math students scored below basic level math proficiency in the United States (National Center for Education Statistics, 2013). Furthermore, 8th grade students in Florida are less proficient in mathematics compared to students in other states (National Center for Education Statistics, 2013). Moreover, the National Assessment of Education Progress (2015) also reported that 4th and 8th grade U.S. students scored lower in math than 4th and 8th grade students in 2013.

The Organisation for Economic Co-operation and Development (OECD) (2015) reported that U.S. students scored lower on the Program for International Student Assessment (PISA) than international students. OECD (2015) also reported that students that participated in the PISA (2015) assessment scored below the overall OECD average. Furthermore, in 2015, students in the U.S. scored eleven points lower on the math section of PISA than students scored on the math section of PISA in the U.S. in 2012: 470 and 481, respectively (The Organisation for Economic Co-operation and Development (OECD), 2015). Other student standardized assessment systems to test student math progress in the U.S. vary within K-12 educational environments: (1) Michigan Student Test of Educational Progress, (2) Florida Standards Assessments, (3) ACT Aspire, and (4) Archdiocesan Standardized Assessment Program (Michigan Department of Education, n.d., Florida Department of Education, n.d., Alabama Department of Education, n.d. & Archdiocesan of St. Louis, n.d.). In 2009, a report by The President's Council on Advisors on Science and Technology (PCAST) recommended that in order to lead the world in STEM (Science, Technology, Engineering, Math) education, educators must implement technologies into the classroom and improve leadership capabilities in the K-12 education.

Scholars in the field of middle school education can obtain further understanding of the utilization of supplemental digital math tools in the classroom based on the results of the study contained herein. First, this study will seek to identify gaps in research findings concerning technology-based math tools in the classroom. Hew & Bush (2007) noted that according to the analysis of recent data more research is needed explaining and exploring the integration of classroom technology and methods of assessment using these digital tools. Studies that further explain and explore how to mitigate these barriers are needed. Second, the research study will increase the knowledge base of experts in the field of educational technology and the leadership needed to successfully implement digital tools into the 6th grade math classroom. School administrators and leaders are critical to the process of impacting current challenges and providing new innovative opportunities that digital tools bring to the classroom (International Society for Technology in Education ISTE, 2015). A study conducted by Webster (2017) found that educational leaders tend to make decisions to integrate technologies in the classroom based on the need to meet the demands of updated technology rather than implementing the technology to meet expected learning outcomes. The results of this study will provide technology integration knowledge to math teachers, education technology leaders, and K-12 administrators. Third, Rocco and Hatcher (2011) emphasized that the application of theory into practice is vital to the integration of digital tools in classroom teaching. Roblyer (2016) highlights that when integrating technologies in the classroom "…learning theories should inform teaching strategies" (p. 33). Ausubel & Robinson (1969) claim that education theory is built on the premise that education administrators and leaders can meet school goals by exploring which methods positively affect student achievement. This study will add to known theory by exploring and explaining how the integration of digital math tools impact 6th grade math classrooms. Finally, research conducted to acquire knowledge about supplemental digital math tools can prompt further research inquiries and discoveries about how and why supplemental math tools impact education.

The study of the integration of digital math tools in private, Catholic schools can benefit the overall education practice in three ways. Bellamy & Mativo (2010) asserted that math students learn more effectively in classrooms that incorporate educational technologies. First, the goal can be achieved by providing real world-learning environments for students through the use of technology (Bellamy & Mativo, 2010). Bower (2016) suggests that educators are not utilizing Web 2.0 technologies to the fullest extent. Bower (2016) notes that recognizing the availability of various Web 2.0 technologies can help faculty choose the most appropriate technologies for classroom activities. Second, Daher (2014) reported that teachers with graduate level degrees are more likely to utilize Web 2.0 in their classrooms and believe Web 2.0 technologies can strengthen pedagogies compared to teachers with undergraduate degrees. Daher (2014) emphasized that administrators can provide appropriate avenues such as workshops, webinars, or training in order to support the use of technological based tools in the classroom. Finally, teachers and leaders can gain critical information regarding the strengths and weaknesses of digital math tools in the classroom. For example, an evaluation brief by the National Center for Education Evaluation and Regional Assistance (2009) concluded that an after school math program designed by Harcourt School Publisher called *Mathletics*™ that incorporated digital math games and interactive activities contributed to an increase in student achievement.

Public policy continues to hold K-12 education accountable for continued improvement of student outcomes by establishing key reforms to strengthen Science, Technology, Engineering, and Math (STEM) education, adding educational technology to the classroom, and providing avenues for leaders to improve their schools. (The U.S. Department of Education, n.d., http://www.ed.gov/k-12reforms). The Florida Department of Education (2014) continues to implement and enforce statewide standards to improve K-12 education in the U.S. Thus, this study will help teachers and leaders incorporate new learning tools in order to meet national and local standards. Picciano, Seaman, Shea, and Swan (2012) indicated a continued increase in online and hybrid learning components offered in K-12 education environments in the future. The study will also provide insights to teachers and leaders about the benefits and drawbacks of utilizing digital tools in the classroom in order to enhance learning to meet national and state standards. Zhang et al. (2015) claims that the rise in the use of tablet computers provides many new benefits for math instruction. Finally, this study will help administrators and leaders make better decisions about digital tools and technology in the classroom. Hutchison & Colwell (2014) disputed that based on a set of emerging empirical research digital tools can help improve curriculum in order to meet Common Core Standards.

Strategies, recommendations, and conclusions from this study can also help school leaders build a knowledge base in many professional practices. Bryson (2011) asserts that the United States has not only faced a number of complex problems that affect politics, health, stock markets, and the housing markets calling for improved decision-making, it is also faced with a dramatic growth in the use of information technology, ecommerce, and e government, which has transformed the expectations of professional work and careers. Advancement in technology has changed the landscape of education and requires leaders to take critical steps in providing society with improved digital training so they are able to perform their jobs effectively (Voogt, Erstad, Dede, & Mishra, 2013). This study will not only provide educational leaders with information on the effectiveness of digital tools in middle school education, it is also interdisciplinary in nature and will provide leaders with critical information to help prepare students with the 21st century skills needed for college and careers.

The results of this study included drawing conclusions, making recommendations and providing evidence-based solutions to faculty, school administrators, school leaders and other stakeholders regarding effective use of *Mathletics*™ and the link between digital math tools and improved grades. This study will also guide future research developments on the utilization of supplemental digital tools for middle school education.

Aim of the Study

The aim of this Dissertation in Practice was to determine whether or not *Mathletics*™ improved *student learning* and *teaching methods* in the 6th grade math classroom and created evidence-based solutions for school leaders from the research findings.

Methodology Overview

This study compared the results of test scores on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores between two iterations of 6th grade groups of learners at three private, Catholic schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™ (*N*=112), while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™ (*N*=127). The 6th grade group of students that used *Mathletics*™ were students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners are students that did not use *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year prior to the implementation of *Mathletics*™ at their respective school. Two sets of quantitative data from three private, Catholic schools in Florida was collected including a summary of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) for a set of 6th grade learners that used *Mathletics*™ and for a second set of learners who did not use *Mathletics*™.

In addition, this study explored the perceived impact of *Mathletics*™ on student learning and teaching methods through qualitative interviews with 12 faculty participants at three Catholic schools in Florida. Qualitative interview data was also collected simultaneously from faculty at three private, Catholic schools in Florida in order to mutually corroborate the findings. During the qualitative strand, the study targeted faculty implementing and utilizing *Mathletics*™ within their respective math classrooms at three private, Catholic schools in Florida. Faculty chosen to participate in the qualitative strand of the study, were participants with the most knowledge about *Mathletics*™.

The quantitative data, Iowa Test of Basic Skills™ (Riverside Publishing, 2008), and the qualitative data, interviews of faculty participants, were collected and analyzed concurrently and separately (Creswell & Plano Clark, 2011). The study allowed the quantitative data and the qualitative interview data to be merged in order to reach an overall interpretation of the research findings (Creswell & Plano Clark, 2011).

Definition of Relevant Terms

The following terms were used for the purpose of this convergent parallel mixed methods study.

Catholic school: An educational institution maintained by the Catholic Church housing students in grades Pre-K - 12.

Standard Score (SS): The standard score is a student score on a standardized test that measures performance on a standard scale (The University of Iowa, n.d.).

Math score: For the purposes of this study, math score is a section of a standardized test that requires a student to exhibit math knowledge. This knowledge includes: number sense and operations, algebraic patterns and connections, data analysis, probability, statistics, geometry, measurement, essential competencies, conceptual understanding, and reasoning (Iowa Test of Basic Skills™ (Riverside Publishing, 2008).

Computation score: For the purpose of this study, computation score is a section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test that requires a student to compute whole numbers, fractions, and decimals (Riverside Publishing, 2008).

6th grade math: For the purposes of this study, 6th grade math refers to students attending a daily class period that includes math instruction. The curriculum could include: basic math functions, order of operations, fractions, decimals, data collection, graphs, basic algebraic expressions, equations, problem solving, reasoning, and critical thinking. Students in 6th grade math are measured for math literacy through standardized testing including the Iowa Test of Basic Skills™ (Riverside Publishing, 2008). The 6th grade math class utilizes *Mathletics*™, supplemental digital math tool.

Educational Leaders: For the purpose of this study, educational leaders refer to administrators with decision-making and leadership roles in Catholic schools. Educational leaders could include superintendents, associate superintendents, principals, and assistant principals.

Faculty: For the purpose of this study, faculty refers to all teachers within the Catholic school.

Assumptions

It is assumed that when comparing the Iowa Test of Basic Skills™ (Riverside Publishing, 2008), scores from two different sets of learners, that both sets of learners have the same mathematics capabilities. School faculty were *purposefully* selected for the qualitative phase of the study and were chosen by each school principal for having the most knowledge of the use of *Mathletics*™ experience in the math classroom. Therefore, it was assumed, faculty chosen for the qualitative interviews by each school principal were the most knowledgeable about *Mathletics*™.

Delimitations and Limitations

The research took place at three private, Catholic schools in Florida. This mixed methods study was limited to three private, Catholic schools in Florida. In addition, the scope of the study was limited to a small quantitative sample size of approximately 240 students, which may affect the generalizability of the study. Due to the small size of the schools, the study was confined to a small sample of 12 participants. The study did not apply to all schools; however, it may be applied to most private, Catholic middle schools in the United States. This study was also confined to the use of *Mathletics*™ in the math classroom. School faculty were *purposefully* selected for the qualitative phase of the study and were chosen for having the most knowledge of the use of *Mathletics*™ in the math classroom. This study included faculty respondents from 1st grade to 8th grade. The implementation and use of *Mathletics*™ in each class from 1st to 8th grade varied. Iowa Test of Basic Skills™ (Riverside Publishing, 2008) data was gathered from 6th grade math students only. Maximum variation sampling, a purposeful sampling procedure, was used to help the researcher gain insightful information from various faculty perceptions (Creswell, 2011).

This study intended to gain faculty perceptions of whether or not *Mathletics*™ improved student learning and teaching methods. It was unknown how *Mathletics*™ was implemented and integrated within each 6th grade math classroom. It is also unknown the exact start and end dates of the implementation and use of *Mathletics*™ in each school or which year the utilization of the tool took place. The researcher is only aware that *Mathletics*™ was utilized as a supplemental digital tool in the classroom for at least one academic school year. The lack of consistent implementation of *Mathletics*™ is a limitation of the study. This includes how long the student spends using *Mathletics*™ in the math classroom, how faculty were trained on the integration and utilization of *Mathletics*™ in the math classroom, and any standardized procedures used by the school in order to implement and integrate *Mathletics*™ in the classroom.

The researcher is a member of a Catholic Church within the Diocese where the study took place. The researcher has also volunteered at one of the private, Catholic schools that participated in the study, and was committed to helping the school. Furthermore, the researcher has viewed Iowa Test of Basic Skills™ (Riverside Publishing, 2008) results and other assessments used in the math classroom prior to the study. The researcher has also observed classroom activities, special events, and consulted with school leadership. In addition, the researcher has experience in academic effectiveness in higher education. This may help the researcher assess the use of digital tools in the math classroom.

Leader's Role and Responsibility in Relation to the Problem

The landscape of education is continuously changing. Advances in technology require school leaders to implement changes to school curriculum in order to meet student needs. New academic standards are also a catalyst for driving change. In 2010, Common Core State Standards were released in order to improve student learning. Rieckhof (2013) insists that today, Catholic school leaders have multifaceted roles that include the complexities of assessing school effectiveness and ensuring students are meeting expected outcomes. Rieckhof (2013) also notes that school leaders should better prepare teachers by providing continuous education on how to improve student learning to meet and exceed stakeholder expectations.

According to Schafer (2004), Catholic school principals are responsible for the "…daily operation of the school" (p. 245). Moreover, Schafer (2004) suggests that both the principal and the pastor are primarily accountable for making the decisions for Catholic schools. Not only are school leaders accountable for decision-making (Schafer, 204), they are also required to drive efforts to make appropriate adjustments to improve school curriculum and contribute to implementing methods to measure student performance (Ediger, 2000).

Leadership is most effective when school leaders delegate tasks to teachers (Hallinger, 2003). A study conducted by Hallinger (2003) suggests that principals that follow the transformative leadership model provide an environment where teachers are included in the leadership process.

Education leaders also utilize student performance data to assist in making critical decisions about improving curriculum and instruction in K-12 learning (Association for Supervision and Curriculum Development (ASCD), n.d.). A study conducted by Brown (2016) indicates that elementary principals find success when data is utilized to make decisions about the improvement of instruction and student learning. Principals can utilize a data-driven model to impact student learning and instructional strategies in the math classroom: (1) Culture, (2) Assessments, (3) Analysis, and (4) Action (Association for Supervision and Curriculum Development (ASCD), n.d.).

The leadership role requires monitoring and assessing the implementation of classroom technology. Assessing the implementation of digital technology in the classroom requires education leaders to define educational goals, identify metrics for measuring the effectiveness of technology integration on student learning, and utilizing feedback for continued improvements to digital technologies used in the classroom (ISTE, n.d.). Frameworks like the technology integration planning (TIP) model aid educational leaders in monitoring the progress of technology integration strategies used in the classroom: "…analysis of teaching/learning needs/objectives, planning tasks, and post-instruction analysis and revisions" (Roblyer, 2016 p. 33).

Effective educational leadership practices also involve building instructional capacity by offering faculty ways to share instructional resources with other faculty members to impact the quality of student learning and teaching methods in learning environments (Jaquith, 2013). Professional learning communities that offer a technology coach provide faculty with effective ways to integrate technological resources in the classroom (Sugar & Slagter, 2014). Sugar & Slagter (2014) emphasize that a virtual technology coach should provide faculty with opportunities for "Collaboration, Discussion, Learning, and Sharing" of technology resources in schools (p. 60).

Summary

Student math achievement is a concern in the United States. Studies have found that students struggle with basic math computation (Programme for International Student Assessment, 2012). Incorporating supplementary digital math tools may help to improve overall student scores. However, further research at private, Catholic schools in Florida is needed in order to determine whether or not a supplemental digital math tool helps to improve student learning. The following Dissertation in Practice intended to determine whether *Mathletics*™, a supplemental digital math tool, improved student learning and teaching methods at three private, Catholic schools in Florida. The next two chapters will use secondary data about K-12 math education in the 21st century to inform whether or not *Mathletics*™, a supplemental digital math, tool improves student learning and teaching and describe the methodology used for collecting information about the Dissertation in Practice problem.

CHAPTER TWO: LITERATURE REVIEW

Introduction

The purpose of this mixed methods study was to determine whether *Mathletics*™ a supplemental digital math tool, utilized in three private, Catholic schools in Florida improved student learning and teaching methods at three private, Catholic schools in Florida. This section examined previous research surrounding the utilization of supplemental digital tools in K-12 education. Previous literature indicated that teachers and educational leaders should continue to explore ways to improve student learning by incorporating digital tools (National Research Council, 2000) and incorporating digital tools such as iPads and applications in the math classroom to improve student learning (Attard, 2013). To assist the reader in establishing a perspective related to supplemental digital math tools used in the classroom, review of literature contained herein was organized by the following themes.

1. Learning in a digital world.
2. Educational learning theory.
3. Student learning outcomes.
4. Teaching Methods and Strategies
5. Digital tools in the math classroom.
6. Literature about the professional practice.
7. Leadership literature.

Purpose Statement

The purpose of this convergent parallel mixed methods study was to determine whether, *Mathletics*™, a supplemental digital math tool, improved student learning and teaching methods at three private, Catholic schools in Florida. In the study, a quantitative research question addressed the relationship of *Mathletics*™ and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores with 6th grade students at three private, Catholic schools in Florida. Qualitative research was also conducted through a standardized qualitative interview protocol to explore the perceived impact of *Mathletics*™, a supplemental digital math tool, on learning outcomes with faculty at the schools. This study used the parallel-databases variant approach where the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores and the interview data was collected and analyzed independently and was mixed to develop an interpretation of the findings (Creswell & Plano Clark, 2011). This convergent parallel mixed methods approach provided rich insight into the effectiveness and perceived strengths, and weaknesses of a supplemental digital math tool and provided a complete understanding of how the findings will impact future leadership decisions by classroom teachers, administrators, and other stakeholders concerning the implementation of digital math tools in the math classroom.

Aim of the Study

The aim of this Dissertation in Practice was to determine whether or not *Mathletics*™ improved *student learning* and *teaching methods* in the 6th grade math classroom and created evidenced-based solutions for school leaders based on the research findings.

Learning in a Digital World

To address stakeholder concerns, the Florida Department of Education (FDOE) has implemented changes that will take effect in 2014-15 school year to standards originally established in 2010 for mathematics (MAFS) and language arts (LAFS). Establishing educational standards provides a consistent method for student outcomes in math and language arts so that students can become successful practitioners in their field (Common Core State Standards Initiative, 2014). Educators will not only be required to follow standards (Common

Core Standards Initiative, 2014), technological advancements will require educators to create and design innovative curriculum in order to prepare and challenge students to think critically and become effective problem solvers (Bevin, Carter, Jones, Moye, & Ritz, 2012). “Children must learn today the skills they will use tomorrow” (Parker & Lazaros, p. 26)

Gunn & Hollingsworth (2013) suggested that teacher centered instructional methods such as face-to-face instruction do not provide students with the required skills to think critically in the digital world. To improve learning methods, educators should continue to explore and implement strategies for teacher and administrator training, tools that enhance student learning, and how technology is utilized in the classroom (National Research Council, 2000). For example, incorporating divergent thinking processes in the social studies classroom can reinforce original and independent ideas and enhance student learning (Gallavan & Kottler, 2012). Gallavan & Kottler (2012) implied that one benefit to divergent thinking is when social studies students practice “depth exploration” to expand their ideas to new directions (p. 169). Dhingra & Sharma (2012) contrasted this idea by concluding in a study that as the student’s age increases, divergent thinking decreases therefore further research on this topic is needed.

Peer-reviewed literature suggests that incorporating various forms of computer-based instruction can have a positive impact on student learning (Chen & Sun, 2012; Gunbas, 2015; Ponce, Mayer, & Lopez, 2013). Although more research for incorporating digital tools in the classroom is needed, Jackson, Brummel, Pollet, & Greer (2013) reasoned interactive media included as an instructional aide in math classes can increase student achievement. Ponce et al. (2013) asserted that students in classrooms utilizing computer-based instruction and spatial learning strategies had improved learning in reading and writing. Chen & Sun (2012) reported that student achievement increased when video-based instruction was incorporated into curriculum of students with both visual and verbal learning styles. Gunbas (2015) concluded that 6th grade math students performed better on math word problems with the use of computer-based story only when it was accompanied by computer-assisted instruction (CAI). Gunbas (2015) used the anchored instruction framework to design story-based instruction that included twelve mathematical word problems and a web project. The study included a pre- and post-test that was provided to 128 6th grade math students in Turkey. Overall, the study indicated that both story based and computer assisted instruction improved student math achievement. Future studies to explore how teachers implement computer-based instructions and spatial learning strategies can provide useful contributions to the field (Ponce et al., 2013).

Tucker & Darling-Hammond (2011) stated that data retrieved from PISA provided critical information for school leaders and teachers to determine how students perform in comparison to other students around the world. Tucker & Darling-Hammond (2011) also suggested that the data from PISA can be utilized to help school leaders and teachers determine the necessary steps to become top performers in the world. In today's global economy, leaders and teachers not only need to prepare students for real world problems by analyzing and synthesizing standardized test data, school leaders and teachers should employ a variety of teaching strategies to reach superior performance. According to Tucker & Darling-Hammond (2011), high performing schools in the world provide effective training programs for school leaders and teachers. Moreover, Tucker & Darling-Hammond added that in the U.S., "we make teachers the object of research rather the people who do the research" (p. 191). High performing schools in the world are trained to analyze the information they have learned in order to make improvements to the learning process (Tucker & Darling-Hammond (2011).

Hattie (2012) insisted that effective schools should deploy transparent student learning outcomes so that school leaders, teachers, and students are aware of what is expected at the end of any lesson. Hattie (2011) asserted that school leaders and teachers should become proficient in the use of providing feedback to students. Hattie (2011) noted that school leaders and teachers should follow student progress by understanding the students' current knowledge and guiding them toward the learning outcome.

Educational Learning Theoretical Perspectives

Educational learning theories influence the design of curriculum and can be applied to modern educational classroom environments. Constructivist learning theory and social cognitive theory serve as theoretical foundations for this study. The constructivist learning theory advocates creativity and innovation in mathematical instruction. The constructivist learning theory aligns with educational environments that integrate digital tools in the classroom. According to Tucker & Darling-Hammond (2011), constructivism is "…the idea first introduced by cognitive psychologists that learning is fundamentally a process in which the students use information from the environment (including the teacher) to construct their own knowledge base, adding new knowledge, piece by piece, to a framework that the students are continually constructing to interpret and understand their world" (p. 31). Dewey (1938), a pioneer in educational theory, envisioned the need for educational models and instructional methods to be continuously transformed to meet societal needs. Dewey (1938) recognized "…that traditional education employed as the subject-matter for study facts and ideas so bound up with the past as to give little help in dealing with the issues of the present and future" (pp. 22-23). The Learner's active participation in the learning process was germane to Dewey's philosophy. He insisted on incorporating the constructivist learning theory in the classroom. Along with Dewey's philosophy of student learning, Piagetian (1970) theory also contributed to the insights of the constructivist framework. Piaget's (1970) emerging perspective reasoned that student learning is a continually process that utilizes life experiences where "…some degree of invention is involved; in development, the passage from one stage to the next is always characterized by the formation of new structures which did not exist before, either in the external world or in the subject's mind" (p. 77).

Brewer (2002) argued that if math teachers align education theory and practice, a positive result would be improved teaching methods. Brewer (2002) highlighted that constructivist approaches to math education include (a) active participation of learners, (b) building on previous knowledge, (c) teachers encourage students' individual thoughts and ideas, and (d) collaboration amongst students and teachers helps foster active learning. Draper (2002) emphasized that a constructivist teacher establishes a classroom environment that encourages learners to be curious and engaged in the learning process. Moreover, Hung (2001) suggested that through social constructivism knowledge is "…socially constructed, and the interpretation of knowledge must be dependent on the cultural and social context through which the knowledge was constructed" (Hung, 2001 p. 283). Hung (2001) also emphasized that both constructivism and social constructivism models highlight the independent elements of learning where students gain individual discoveries of mathematical computations and social constructed aspects of cognitive learning where students interact through discussions and projects with other students.

Building on the constructivist learning theory and Dewey's views on educational models and instructional methods, Albert Bandura's (2001) social cognitive theory suggested that learning occurs through modeling and self-efficacy. Bandura (2001) emphasized that learners can build knowledge by "…extensive modeling in the symbolic environment of the mass media"

(p. 271). Roblyer (2016) argued that the role of a teacher is to ensure they are modeling positive behaviors that would foster student self-efficacy.

Student Learning Outcomes

School leaders and teachers are accountable for assessment of student learning. There are many methods and frameworks that are utilized to effectively assess student learning. From the literature, several taxonomies have been implemented in education to assess student outcomes. Bloom (1956) designed a classification of intellectual behavior: knowledge, comprehension, application, analysis, synthesis, and evaluation. Later, Anderson & Krathwohl (2001) updated Bloom's taxonomy to reflect a more recent classification aligned with 21st century academia: remembering, understanding, applying, analyzing, evaluating, and creating. Similar to Bloom's (1956) taxonomy, Ausubel and Robinson (1969) developed a hierarchically ordered taxonomy composed of six categories: Representational Learning, Concept Learning, Propositional Learning, Application, Problem Solving, and Creativity. The reflective thinking measurement model adapted in the 1990's assesses the non-reflective and reflective aspects of student written work (Chan, Tsui, Chan, & Hong (2002). An empirical study conducted by Chan et al., (2002) suggested Bloom's, SOLO, and the reflective thinking measurement model are closely related instruments to assess student learning outcomes, while "each could complement the weaknesses of the others" (p. 518). Merrill's component display theory (1994), a two dimensional model, used a matrix to measure student performance: Remember Instance, Remember Generality, Use, and Find and to measure Subject Matter Content: Fact, Concept, Procedure, and Principle (Anderson & Krathwohl, 2001). Although there is no standard way to measure student outcomes, the practices and taxonomies used help to assess student thinking and learning (Bloom, 1956; Anderson et al., 2001; & Ausubel et al., 1969).

Teaching Methods and Strategies

Educational leaders and teachers utilize a mixture of teaching methods and strategies to impact student learning goals in K-12 math classrooms (Ozel, Yetkiner, & Capraro, 2008). Hattie (2012) noted that teachers should focus on impacting student learning by integrating a variety of teaching strategies to meet individual student needs. Roblyer (2016) indicated that students learn at different speeds. Ozel et al., (2008) emphasized that technology can be used to offer teachers alternative ways of teaching and students individualized learning approaches. Seeking feedback about student progress is a way of thinking that provides educational leaders and teachers with information to make decisions about the choice of teaching method to meet student needs (Hattie, 2012).

Technology teaching and learning strategies are used to meet Common Core Math Standards. (Roblyer, 2016). Roblyer (2016) suggested a variety of technology teaching strategies for the math classroom: problem solving, data-driven instruction, and the use of virtual manipulatives to demonstrate abstract concepts. Programs integrated to improve student learning and teaching methods like problem-based learning and the Integrated Dynamic Representation strategy (IDR) are examined in K-12 environments (Scogin, Kruger, Jekkals, & Steinfeldt, 2017; Gonzalez-Castro, Cueli, Cabeza, Alvarez-Garcia & Rodriguez, 2014).

A concurrent-parallel mixed methods study found that students that participated in a middle school experiential learning program enjoyed school more, increased non-cognitive skills, and showed evidence that students met standardized testing expectations along with other students in traditional classroom environments. (Scogin, Kruger, Jekkals, & Steinfeldt, 2017). Scogin et al., (2017) also found that experiential pedagogies like problem-based learning (PBL) contributed to increased student freedom and improved student collaboration. Implementation of

PBL in STEM education varies in educational settings (Hall et al., (2016). Moreover, Hall & Miro (2016) indicated that PBL activities are more frequently used in Engineering Optional Program (EOP) and Virtual STEM Academy (VSA) classroom programs. Hall et al, (2016) emphasized that professional development programs that build teacher knowledge about PBL use in the classroom will improve student learning and engagement in STEM educational environments. Gonzalez-Castro, Cueli, Cabeza, Alvarez-Garcia & Rodriguez (2014) examined two groups of math students between the ages of 6 and 8 years of age to determine whether an Integrated Dynamic Representation strategy (IDR), a digital tool, impacted basic math skills. Gonzalez-Castro et al., (2014) found that IDR had a positive impact on applied mathematical competencies, but not on automatic mathematics and mental arithmetic. Sahin & Top (2015) highlighted that a STEM Students on the Stage (SOS) model, a model that incorporates a variety of methods including interdisciplinary strategies, project-based learning, and standards, increased student knowledge and developed 21st century skills in high school students. The National Education Association (n.d.) suggested that project-based learning is a student-centered approach that enables students to engage in solving real-world complex problems.

K-12 education is utilizing digital tools like mobile applications in the classroom; however the lack of applications that support collaborative progressive inquiry and project-based learning are evident (Leinonen, Keune, Veermans, & Toikkanen, 2016). A study conducted by Leinonen et al. (2016) concluded that applications for audio-visual recordings on mobile devices could encourage reflective practices in K-12 learning environments (Leinonen, et al., 2016). Ozel et al., (2008) noted that Internet applications that students are accustomed to provide educational leaders and teachers a practical and flexible teaching strategy in K-12 math learning environments.

Digital Tools in the Math Classroom

Researchers have found that the integration of digital math tools has the potential to enhance student learning (Attard, 2013; Beserra, Nussbaum, Zeni, Rodriquez, & Wurman, 2014; Hammonds, Matherson, Wilson, & Wright, 2013). Researchers have also argued that educational technologies do not fully support improved teaching and learning in a K-12 education (Murray, & Olcese, 2011). Hammonds et al. (2013) noted that teacher's awareness of the value of technology is the most vital in effective uses of technology in the classroom. Effective methods, frameworks, and teaching strategies are vital to the improvement of student learning and achievement. Firmender, Gavin, & McCoach (2014) asserted in a recent study a positive association existed between verbal communication and mathematical vocabulary in the K-12 classroom resulted in student math achievement on Open-Response Assessments. Doabler, Baker, Kosty, Smolkowsk, Clark, Miller, & Fien (2015) noted a positive relationship between "…the rate of explicit instructional interactions and student mathematics achievement" in the kindergarten classroom (p. 323). Moreover, Ganesh & Middleton (2006) suggested that as teachers utilize technologies in the math classroom, clear communication of instruction and learning objectives is paramount. A study conducted by Research for Action (2015) concluded that Literacy Design Collaborative (LDC), a platform that includes assessment tools, improves student learning. A survey conducted by Research for Action (2015) of 1,500 teachers reported that tools in the classroom help them to: "learn new strategies for teaching subject matter and literacy skill; use formative assessment and learn about students' strengths and weaknesses; provide feedback to students; increase rigor; raise their expectations for students; differentiate instruction; and engage students" (p. 2).

Researchers Murray & Olcese (2011) studied whether or not incorporating iPad and educational applications would have an affect on the K-12 classroom environment. Murray & Olcese (2011) asserted that applications such as 3D4 Medical Images and Stickyboard had the potential to enhance teaching and learning; however, the study did not include ways for students to collaborate, which is needed to support 21st century learning. 3D4 Medical educational applications are used to teach students about anatomy, health, and fitness (3D4Medical, n.d.). Stickyboard allows users to arrange creative ideas and identify patterns and relationships on a single computer interface. Murray & Olcese (2011) recognized that applications that enable users to share information such as a Whiteboard foster the potential of collaboration in the K-12 classroom. Murray & Olcese (2011) noted that the development of applications such as 3D4 Medical Images and Stickyboard should attempt to link to education theories. Overall, Murray & Olcese (2011) concluded that teaching strategies should focus more on modern theories of teaching and learning in K-12 so that students are prepared to interact in the 21st century.

Larkin (2014) researched and critiqued approximately 4000 mathematics applications and found that an application's description did not provide adequate information for teachers to determine which application to utilize in order to provide their students with mathematical understanding. Out of 142 applications reviewed, the researcher found that 40 applications were appropriate for Australian mathematical instruction and requirements. Larkin (2014) devised a document that reviewed over 100 applications for math teachers to quickly identify useful digital tools to enhance mathematical understanding. The researcher plans to update this document to include additional applications that are effective in the math classroom.

Attard (2013) asserted that the use of iPads and game applications are an innovative way to engage math students. Beserra et al. (2014) pointed out that based on emerging data that although game-based activities do not impact the final result of student learning in math, students demonstrated higher levels of interest when games were integrated into the classroom. Moreover, Beserra et al. (2014) added that students had an increase of knowledge in arithmetic when the use of technology was utilized in the classroom than those learning from non-technical traditional methods. Carr (2012) contrasted this idea by finding that there was no direct connection with the use of iPads in the math classroom and student achievement. Carr (2012) conducted a qualitative, quasi-experimental study of 104 fifth grade math students. The study examined two groups of students. One group of students used iPads in the math class for nine weeks and the other group did not use iPads during the math class. A pre- and post-test was administered to both groups of students to determine whether or not there were any significant changes in learning. Carr (2012) found no significant changes in student learning during the study period. Carr (2012) recommended that further research is needed to add additional students to the study, increase the time of the study beyond the 9 weeks, and include qualitative data. Falloon (2013) argued that effective design of iPad applications in communicating learning objectives and offering learners clear directions and practice is essential to engaging students in meaningful learning; he concluded that more research is needed to improve the overall design of learning applications for pedagogy. Falloon (2013) suggested that application developers should pay close attention to the design of the applications in order to create understandable learning objectives, design more effective ways to achieve goals, include instructions that are easy to access and understand, provide ways that will enable effective feedback, incorporate a mix of learning strategies, and match curriculum to learner characteristics. Finally, Falloon (2013) reported that better design of learning applications include both free and paid-for versions. Melero & Hernandez-Leo (2014) reported that although teachers create and use paper-based games to help engage student learning, educational game-based technologies are not widely adopted because teachers lack the knowledge and training to create effective game-based designs. Melero & Hernandez (2014) suggested that puzzle-based games are a great alternative to computer-based games because they are easy to design and implement in the classroom. Robin (2008) reasoned that future research studies that explore the integration of digital storytelling and Technological Pedagogical Content Knowledge (TPCK) in instructional technology will improve teaching and learning. The Department of Education (2007) conducted a study to find whether or not the use of computer software had an impact on student achievement. The Department of Education's (2007) study concluded that math and reading classrooms in K-12 education that utilized computer software did not show higher assessment scores than classrooms that did not utilize the same computer software. However, Robin (2008) suggested that frameworks such as TPCK can be used with digital storytelling in order to "…engage and motivate both teachers and students" (p. 226). Robin (2008) suggested that in order to diffuse the debate over whether or not technologies in curriculum can benefit education, more studies in this area are needed.

Literature about the Professional Practice Setting

Daily (2015) proposed that certain skills and knowledge beyond the Catechism are vital to a deeper understanding of one's relationship with God and active participation in the church. Catholic schools in Florida prepare students for college and future employment by implementing a variety of instructional tools and teaching methods that align with the ongoing changes in technology and the many challenges that face today's global market (Florida Conference of Catholic Bishops, 2013). According to the Center for Catholic School Effectiveness (2012), Catholic schools in the U.S. align curriculum and instruction that is consistent with current U.S. National Standards and Common Core Standards.

Administrative leaders and teachers of Catholic schools in the Florida Diocese collaborate with parents to create educational instruction that foster critical thinking and creativity whilst integrating the Gospel within the curriculum (Orlando Diocese, n.d.). Catholic schools in Florida are accredited by the Florida Catholic Conference (Orlando Diocese, n.d.). Catholic teachers at the schools of the Diocese in Florida are certified by the Florida Department of Education (Orlando Diocese, n.d.). Each year the U.S. Department of Education (n.d.) recognizes schools that demonstrate academic excellence or for closing achievement gaps by awarding them as a Blue Ribbon School. The U.S. Department of Education (n.d.) recognized 19 Catholic schools within a Diocese in Florida as a National Blue Ribbon school for achieving a high quality of leadership, teaching, curriculum, student achievement and parental involvement (Orlando Diocese, n.d.). The Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized tests are given to all middle schools students attending Catholic schools in a Diocese of Florida (Orlando Diocese, n.d.). According to 3plearning (n.d.), a total of nine schools in a Diocese in Florida utilize *Mathletics*™.

The private Catholic schools' mission statement emphasizes the importance of inspiring students to live and learn through the gospel of Jesus Christ (Orlando Diocese, n.d.). The school's philosophy is to build an environment that challenges students to live in faith, while achieving academic excellence (Orlando Diocese, n.d.). The private Catholic schools included in this study enroll students from pre-kindergarten to eighth grade. The setting of instruction for 6^{th} grade classrooms are departmentalized.

Catholic school one includes a principal, assistant principle, 7 office staff, and 34 faculty members. In 2015 the school has enrolled 705 students including 5 of American Indian and Alaskan, 35 Asian and Pacific Islander, 1 Black, 192 Hispanic, 401 White, and 71 unknown students. It enrolls 52.91% female and 47.09% male students. In 2006, the school was awarded as a Blue Ribbon Nationally Accredited school, scoring in the top national percentiles in standardized testing as measured by the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized tests. The school offers an extended day program to enhance the Catholic school experience. The school also offers a Community Outreach program that students have the opportunity to engage in community service activities.

Catholic school two has enrolled 181 students including 1 of American Indian and Alaskan, 7 Asian and Pacific Islander, 6 Black, 15 Hispanic, 139 White, and 13 unknown students. It enrolls 85 female and 96 male students. The school offers a variety of extra curricular activities including sports, clubs, and councils. The school offers an extended day program to enhance the Catholic school experience. The school was awarded as a Blue Ribbon Nationally Accredited school. The school has scored in the top 10% on standardized tests scores in the nation as measured by the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized tests.

Catholic school three includes 1 principal, 40 staff members including 25 faculty members. Catholic school three has enrolled 384 students including 1 of American Indian and Alaskan, 31 Asian and Pacific Islander, 15 Black, 96 Hispanic, 241 White, and 0 unknown students. It enrolls 193 female and 191 male students. The school houses 27 classrooms that include 21st century digital technology tools. The school also offers a learning center with technology. The school provides extracurricular activities that include: honor societies, sports, the arts, and clubs. The school was awarded as a Blue Ribbon Nationally Accredited school.

The three Catholic schools provide the students with computer devices and integrated technology curriculum so they have the opportunity to learn in digital formats. The schools incorporated *Mathletics*™ in order to improve math scores. The Catholic schools are dedicated to instilling the Catholic Faith.

Leadership Literature

Educational leaders, namely school administrators and teachers, are faced with affecting student learning by adhering to requirements set forth by state departments of education (Eilers & D'Amico, 2012). In 1983, a report titled A Nation at Risk emphasized that due to the rise in computers and technology use, schools in the U.S. are faced with an ongoing crisis to implement change to meet the demands and requirement enforced by stakeholders in education. As a result, the advent of No Child Left Behind (NCLB) act of 2001 has added urgency, immediacy, and increased accountability to academic performance and teaching practices in schools. Furthermore, the Every Student Succeeds Act (ESSA) (2015) was signed by former President Barack Obama to support schools in providing useful assessment data for decision-making, ensuring high standards and availability to resources for all students, supporting school innovations, and increasing school accountability to improve student achievement (U.S. Department of Education, 2015).

Educational leaders are accountable for successfully implementing effective changes to meet the demands of departmental standards such as Common Core State Standards Initiative (CCSI) (Eilers & D'Amico, 2012). Eilers & D'Amico (2012) highlights six critical factors as a framework to guide educational leaders when implementing changes to meet departmental standards. These include the following:

- *Purpose* – Developing a strategic vision that delineates the actions taken to implement change.
- *Alignment* – Understanding the strengths of individual faculty members in order to align them with the strategic vision.

- *Priorities* – Identifying and prioritizing tasks in order to meet teaching and learning needs.
- *Professional Discourse* – Building a community that fosters collaboration, continuing education, and planning.
- *Risk Taking* – Establishing a workplace that enables teachers to make recommendations on making changes in order to solve complex problems.
- *Feedback* – Providing effective feedback in order to improve performance.

The Florida Department of Education (n.d.) established 10 leadership standards for effective principals: (1) achieving student outcomes, (2) student learning is a principal's main priority, (3) developing instructional curricular that meets state departmental goals and student needs, (4) maintaining an effective teaching staff (5) providing a quality education to all students, (6) demonstrating effective decision-making skills, (7) mentoring potential future school leaders, (8) managing operational processes in order to maximize resources, (9) practicing effective communication skills and promoting collaboration, and (10) demonstrating ethical behaviors. The first standard, achieving student outcomes, provides a strong rationale for the school to implement and utilize digital math tools in the math classroom. Based on these standards, educational leaders are responsible for implementing appropriate frameworks, methods, and strategies to improve teaching and learning practices in schools. Educational reform is not an easy process and requires all levels of the institution to affect change (Spillane, Hunt, & Healey, 2009).

Teachers can also take a leadership role in a K-12 environment. Spillane & Diamond (2009) noted that a leader is anyone that provides a recommendation to at least 3 other employees. Nappi (2014) suggested that principals should distribute leadership roles to include teachers in order to improve the effectiveness of the school. Educational leaders enhance the school by fostering new frameworks that leverage the entire educational community (Murphy, 2016).

Summary

The purpose of this mixed methods study was to determine whether a supplemental digital math tool utilized in a private Catholic school increases student test scores at three private, Catholic schools in Florida. Although previous literature indicated that teachers and educational leaders should continue to explore ways to improve student learning by incorporating digital tools (National Research Council, 2000), the studies that are reviewed in this literature are immeasurable insights that will help guide and support this study. Learning in a Digital World, Educational Learning Theory, Student Learning Outcomes, Teaching Methods and Strategies Digital Tools in the Math Classroom, Literature about the Professional Practice, and Leadership Literature are critical themes that contribute to the study.

School leaders and teachers are required to reform learning in order to follow academic standards (Common Core State Standards, 2014). In order to do so, educators should implement new and engaging teaching strategies to improve learning (National Research Council, 2000). Previous literature suggested that there is a positive impact on student learning when technology is incorporated into the classroom (Chen & Sun, 2012). However, research is still needed to explore how teachers implement and utilize technology such as computer-based story and CAI in the classroom (Ponce et al., 2013).

School leaders and teachers are essential in improving student learning. Leaders can utilize taxonomies and follow standards in order to improve student outcomes. Achieving student outcomes provides a strong rationale for school leaders to incorporate effective digital math tools in the classroom.

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this convergent parallel mixed methods study was to determine whether a *Mathletics*™ improves student learning and teaching methods at three private, Catholic schools in Florida. In the study, a quantitative research question addressed the relationship of *Mathletics*™, a supplemental digital math tool, and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores with two sets of 6th grade students at three private, Catholic schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™. The 6th grade group of students that received *Mathletics*™ are students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners are students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year prior to the implementation of *Mathletics*™ at their respective school. A standardized qualitative interview protocol was also used to explore the perceived impact of *Mathletics*™, a supplemental digital math tool, on learning outcomes with faculty and at the school. This convergent parallel, mixed methods approach provided rich insight into the effectiveness and perceived strengths, and weaknesses of a *Mathletics*™ and provided a complete understanding of how the findings will impact future leadership decisions by classroom teachers, administrators, and other stakeholders concerning the implementation of digital math tools in the math classroom. During the qualitative strand, the study population targeted faculty implementing and utilizing *Mathletics*™ within their respective math classrooms at three private, Catholic schools in Florida. School faculty were purposefully selected by each school's principal for the qualitative phase of the study and were chosen for having the most knowledge of the use of *Mathletics*™ experience in the math classroom.

Research Questions

The following research questions guided this convergent parallel mixed methods study:

Central Research Question

The central research question for this study is:

- Does the integration of interactive media such as *Mathletics*™ improve student learning and teaching methods in the 6th grade math classroom?

Quantitative Research Question

For the quantitative phase of this study the guiding research question is:

- Did *Mathletics*™ improve student learning based on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores when comparing the achievement of 6th grade students who participated in *Mathletics*™ and students who did not participate in *Mathletics*™?

Qualitative Research Question

For the qualitative phase of this study the guiding research question is:

- What are faculty perceptions of whether or not *Mathletics*™ improves student learning and teaching methods?

Method

This study intended to compare the results of test scores on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores between two sets of 6th grade learners at three private, Catholic schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™. The 6th grade group of students that received *Mathletics*™ were students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners were students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year prior to the implementation of *Mathletics*™ at their respective school. Quantitative data from three private, Catholic schools in Florida were collected including a summary of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) for two, sixth grade classes. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™.

During the quantitative strand, three private, Catholic schools in Florida provided the researcher with a summary of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) for two sets of 6th grade learners. The researcher used the developmental standard scores (SS) of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) that included the *math* section and the *computation* section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008). One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™. The 6th grade group of students that received *Mathletics*™ are students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners are students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year prior to the implementation of *Mathletics*™ at their respective school. Data from two sets of 6th grade learners prior to the implementation of *Mathletics*™ at their respective school and after the implementation of *Mathletics*™ at their respective school were provided to the researcher which included the number of students tested and the developmental standard score of each class. The two sets of 6th grade classes from three private, Catholic schools in Florida prior to and after the implementation of a supplementary digital math tool was implemented are two entirely different sets of learners.

The study also explored the perceived impact of *Mathletics*™ on student learning and teaching based on the results of the comparison of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) between two sets of 6th grade learners at the same three private, Catholic schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™. *Mathletics*™, a supplementary digital math tool, is an online platform used to improve math results at private Catholic schools in Florida. Qualitative interview data were collected from 12 faculty at three private, Catholic schools in Florida in order to mutually corroborate the findings. In the qualitative strand, the researcher included participants implementing and utilizing a digital math tool within their respective math classrooms at three private, Catholic schools in Florida. School faculty were *purposefully* selected for the qualitative phase of the study and were chosen for having the most knowledge of the use of *Mathletics*™ experience in the math classroom.

The purpose of collecting interview data was to develop a more complete understanding of the extent to which *Mathletics*™ impacted learning outcomes and impacted teaching methods based on faculty perceptions (Creswell & Plano Clark, 2011). In the qualitative strand, the study population targeted faculty implementing and utilizing *Mathletics*™ within their respective math classrooms at three private, Catholic schools in Florida. Faculty participants chosen for the interviews during the qualitative phase were participants with the most knowledge about *Mathletics*™.

For this convergent parallel mixed methods study primary and secondary research were used to inform whether or not *Mathletics*™, a supplemental digital math tool, improves student learning and teaching. In this design, data collection and analysis of the quantitative and qualitative data were conducted at the same time. The quantitative and qualitative data were merged allowing both sets of data to develop a better understanding to help answer the research questions Creswell & Plano Clark, 2011). The use of the mixed methods study helped drive toward a deeper understanding than it would with only having one data source when explaining the impact of *Mathletics*™ in the math classroom. The convergent parallel study utilized Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores and interview data to help build a better understanding of the impact of *Mathletics*™ on *student learning* and *teaching methods* in 6th grade educational environments.

Data from the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) and interviews were independently collected and analyzed until the end of the study when the two strands were merged in order to provide recommendations and conclusions about digital math tools in the classroom (Creswell & Plano Clark, 2011). The data were merged by interpreting and comparing the results by representing in a matrix how results from interview data explain 6th grade Iowa Test of Basic Skills™ (Riverside Publishing, 2008) assessment scores (Creswell & Plano Clark, 2011). When converged, the data sets had different samples and sizes. The data were collected and analyzed concurrently with the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) and interviews having equal value. The researcher felt that both phases of data collection were essential for determining whether a digital math tool improves student learning and teaching methods at three private, Catholic schools in Florida (Creswell & Plano Clark, 2011). Secondary data from literature related to K-12 math education in the 21st century were also used to inform this study.

Description and Rationale of Participants

In the quantitative phase, the researcher used two iterations of 6th grade learners to seek whether or not *Mathletics*™ improved student learning and teaching methods in three, private schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™ (N=127), while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™ (N=112). The 6th grade group of students that received *Mathletics*™ are students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners are students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) prior to the implementation of *Mathletics*™ at their respective school. To illustrate this, the quantitative phase of the data collection consisted of two iterations of 6th grade assessment scores. The 6th grade class Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores that did not use the digital math tool will be compared to 6th grade class Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores that used the digital math tool. The two assessment scores for both academic years were compared to identify whether or not the digital math score improved assessment scores between the two academic years. Each school implemented *Mathletics*™ in different academic years, so the academic year for each school varied.

The sample population for the quantitative strand of the study were 6th grade learners. Learners of Catholic schools for this study are assessed by Iowa Test of Basic Skills™ (Riverside Publishing, 2008) on a yearly basis to measure student achievement. In 2015, although learners in the 6th grade scored above the National math average on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008), the same 6th grade learners received a lower average math score on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) than learners in all other K-8 grades from the same Diocese and province (Orlando Diocese, n.d.). The 6th grade classrooms at private, Catholic schools in Florida utilize technologies like iPads, computers, and SMARTBoards to help impact student achievement and learning outcomes. Subjects for middle at a Catholic middle school includes Math, Language Arts, Science, Social Studies, Religion, Physical Education, Health, Foreign Language, Technology, Music, and Art. The 6th grade classes in Catholic schools align with the National, state, and Diocesan standards (Orlando Diocese, n.d.). The 6th grade curriculum also includes teachings of the Catholic tradition.

In the qualitative phase, the study population targeted faculty implementing and utilizing a digital math tool within their respective math classrooms at three private, Catholic schools in Florida. Individual participants were chosen by each school's principal for interview data collection due to having the most specialized knowledge of the digital math tool utilized in the classroom and willingness to participate in the study. Faculty selected for the study were most familiar with using the digital math tool with the learners in a classroom setting. Choosing faculty most familiar with the digital math tool helped gain an insightful and constructive view of the tool. Four faculty members from each school from various grades (Kindergarten to 8th grade) were selected for the interview process. Faculty chosen for the study utilized the digital math tool in their respective classrooms for more than one year. Teacher-participants who have not utilized the digital math tool within their respective classes for at least one year, were not be part of the study. Experience using the digital math tool was required to answer the questions for the qualitative phase.

Data Collection Tools

Creswell (2011) puts forth that data from the qualitative and quantitative phases will be recorded, coded, and analyzed. Data collection from the assessment scores and interviews were different sample types (Creswell, 2011). The assessment scores were generalizable to comparable populations of private, Catholic schools, and the interviews included in-depth individual interviews of faculty perceptions considering the uses of digital math tools in classroom settings (Creswell, 2011). Creswell (2011) explained that both data strands will have similar concepts in order to merge the 6th grade Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores and interview descriptions effectively.

The quantitative phase of the data collection consisted of two iterations of 6th grade Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores from one group of 6th graders that received *Mathletics*™ and one comparison group that did not receive *Mathletics*™. The Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores were obtained from three private, Catholic schools in Florida that utilized *Mathletics*™ in the 6th grade classroom. The two groups of 6th grade assessment scores were compared to identify whether or not the digital math tool improved assessment scores. Data analysis for the quantitative strand required the researcher to utilize SPSS 22 software to address whether or not a supplemental math tool improved learning at three private, Catholic schools in Florida (Creswell & Plano Clark, 2010). The math and computation sections of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) were analyzed separately during the study. An independent-samples t-test was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the math section of 6th grade math students (N=112) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. A Welch's test and a Mann-Whitney U test in SPSS was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the computation section of 6th grade math students (*N*=127) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. Implementation of *Mathletics*™ was in place approximately one academic school year prior to taking the standardized assessments.

The qualitative phase of the data collection consisted of collecting interview data from a combination of 12 academic faculty members from three, Catholic schools in Florida. Maximum variation sampling, a purposeful sampling strategy was used in order to gain insightful perceptions from a variety of angles within the three private, Catholic schools in Florida (Creswell, 2013). Common themes were identified across the sample of interview descriptions (Creswell, 2013). The researcher recorded, transcribed, and coded the data from each interview. Dedoose qualitative data analysis software was used to analyze the emergent interview themes. The researcher collected, analyzed, and synthesized data from the interview responses to identify common themes. The use of a digital voice recorder and hand written notes were used to collect, save, and archive the original interview data. Responses to the interview questions were also coded manually in order to retrieve the perceived strengths and weaknesses to implementing supplementary digital math tools in the math classroom for private, Catholic schools. Categorizing the interview data by using open coding and then identifying one category within the open coding using axial coding to highlight one common theme within the interviews will be used (Creswell, 2013). The researcher then reread the transcripts and used the selective coding process to identify overall core themes (Creswell, 2013). A comparison table was created to represent the data and its final concepts (Creswell, 2013). Member checking was utilized to act as a quality control process to strengthen the internal and external validity of the interview data from faculty and administration (Creswell, 2011). The inter-rater reliability procedure was used to ensure reliability of the interview data (Creswell, 2011).

After the data was collected, analyzed, and synthesized, data from the quantitative and qualitative strands were merged. The overall analysis of the study led to answering research questions, drawing conclusions, and making recommendations about digital math tools in private, Catholic school educational settings.

All data collected from the quantitative and qualitative strands were stored on an encrypted external hard drive. All institutional, administrative, and faculty names were replaced with alternative names for anonymity in both the quantitative and qualitative phases. The researcher stored all related materials from this study on an encrypted external hard drive. In accordance with University policy, the data was archived for three years. After three years, all data and related materials will be removed and deleted from the encrypted external hard drive.

Variables (Quantitative)/The Researcher's Role (Qualitative)

Quantitative Variables

For the quantitative strand of the study, the independent variables included 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™. The dependent variables for this study included developmental standard scores (SS) for the *math* section and *computation* section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008).

The Researchers Role

During the qualitative strand of this study, the researcher collected, analyzed, and validated the data. The researcher volunteered and was familiar with student test scores at one of the three private, Catholic schools that participated in the study. The researcher attended religious services at the parish of one of the Catholic schools utilized in this study. The researcher kept a hand-written journal that reflected on the thoughts and feelings through the dissertation process that included: decisions about methodology, proposal process, collection of data, participant interview procedures, writer's block, and dissertation defense presentation. The journaling process helped the researcher overcome fears about dissertation writing, resolved problems that were encountered, and provided an avenue to record challenges and successes. Most importantly, because the researcher was a member of the Catholic parish of one of the schools associated with the study, the researcher used reflexivity to set aside any preconceived ideas about the study. A bracketing journal was kept to mitigate preconceptions of any beliefs, views, and biases of previous research or knowledge pertaining to this study; and the collection and analysis processes used for this study.

Data Collection Procedures

The convergent parallel study used quantitative data from Iowa Test of Basic Skills™ (Riverside Publishing, 2008) math scores and from open-ended, one-on-one qualitative interview questions. The study analyzed the quantitative assessment data and qualitative interview data separately in order to represent, interpret, record, and validate these data (Creswell & Plano Clark, 2011). The quantitative and qualitative data were collected concurrently. The researcher collected all Iowa Test of Basic Skills™ (Riverside Publishing, 2008) math scores from two sets of 6th grade learners at three, private Catholic schools in Florida. Individual participants (N=12) were chosen for interview data collection due to having the most specialized knowledge of the digital math tool utilized in the classroom and willingness to participate in the study. Participants with the most specialized knowledge used *Mathletics*™ in the classroom for at least one year.

Data from the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) was provided by the principal of each school to the researcher in the quantitative strand. The educational leadership from the three private, Catholic schools in Florida provided the researcher with a summary of two iterations of 6th grade learners. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™ (*N*=127), while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™ (*N*=112). The 6th grade group of students that received *Mathletics*™ are students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners are students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) prior to the implementation of *Mathletics*™ at their respective school. To illustrate this, the quantitative phase of the data collection consisted of two iterations of 6th grade assessment scores. The 6th grade class Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores that did not use the digital math tool were compared to 6th grade class Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores that used the digital math tool. The two assessment scores for both academic years were compared to identify whether or not the digital math score improved assessment scores between the two academic years. Each school implemented *Mathletics*™ in different academic years, so the academic year for each school varied. For example, school one could have implemented *Mathletics*™ in the 2013 – 14 school year, school two could have implemented *Mathletics*™ in the 2014 – 15 school year, and school three could have implemented *Mathletics*™ in the 2012 – 13 school year.

In the qualitative phase, the study population targeted faculty implementing and utilizing a digital math tool within their respective math classrooms at three private, Catholic schools in Florida. The researcher consulted with the principal from each school to receive guidance in recruiting the most knowledgeable participants. While utilizing purposive sampling, the researcher collected data through interviews with faculty to explore whether a digital math tool improves student learning and teaching. Upon approval of the Institutional Review Board (Appendix A), maximum variation sampling, a purposeful sampling strategy, was used in order to gain insightful perceptions from a variety of angles within the three private, Catholic schools in Florida (Creswell, 2013). Individual participants were chosen by each school's principal for interview data collection due to having the most specialized knowledge of the digital math tool utilized in the classroom and willingness to participate in the study. Twelve faculty members agreed to participate in the study. Prior to the interview process, a pilot interview study including 2 faculty members was conducted to determine whether or not the interview questions would obtain rich and insightful information. The researcher listened to the pilot interview data and determined the questions were effective. After the pilot interviews were complete, the researcher conducted 12 face-to-face interviews. The interviews were recorded and hand written notes were taken. Each faculty member received a copy of the interview protocol (Appendix B), an information letter describing the details of the study (Appendix C), and a copy of Bill of Rights for Research Participants informing them of their rights as research participants (Appendix D). Faculty participants were informed during the interview procedure that their transcripts were available for review following the interview. The information letter complied with Creighton University's research policies and included the following information.

- Introduction to the study.
- An invitation to participate in the research study.
- Details about the study.
- Risks to the research participants.
- The benefits of the research.
- Confidentiality and anonymity of the research participants.
- Compensation.
- Creighton University's Institutional Review Board contact information.

Faculty participants were assured their identity would not be shared within the dissertation in practice manual. After each individual interview, the faculty participants were notified of their ability to view the transcript in order to edit or correct information. The researcher conducted internal validity strategies including member checking and inter-coder reliability. External data collection was completed by the end of October 2015.

Data Analysis Plan

The convergent parallel design data from both the quantitative and qualitative strands were collected and analyzed separately and represented in a table (Creswell, 2011). Data analysis for the quantitative strand required the researcher to utilize SPSS 22 software to address whether or not a supplemental math tool improved learning and teaching at three private, Catholic schools in Florida (Creswell & Plano Clark, 2010). The math and computation sections of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) were analyzed separately during the study. An independent-samples t-test was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the math section of 6th grade math students (*N*=112) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. The independent-samples t-test in SPSS was specifically used to determine whether there was a difference between the two 6th grade groups of students and if the two groups were statistically significant. A Welch's test and a Mann-Whitney U test in SPSS 22 was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the computation section of 6th grade math students (*N*=127) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. A Welch's test and Mann-Whitney U test were performed to determine whether there was a difference between the two groups because the data failed the assumptions of the Independent-samples t-test. Details of the results of the SPSS 22 tests used for this study will be discussed in Chapter 4.

Dedoose qualitative data analysis software was used to analyze the emergent interview themes. The researcher collected analyzed, and synthesized data from the interview responses to identify common themes. The coding process to determine the common themes included three phases: open coding, axial coding, and selective coding (Creswell, 2013). After the data were collected, analyzed, and synthesized, data from the quantitative and qualitative strands were merged. The overall analysis of the study will lead to answering research questions, drawing conclusions, and making recommendations about digital math tools in private, Catholic school educational settings.

Assumptions (Quantitative)/Quality and Verification (Qualitative)

Verification

The researcher utilized several approaches to verify the accuracy of the qualitative research data (Roberts, 2010). A reflexive journal was kept to record the researcher's ideas, thoughts, and insights on specific events during the study: proposal, decision of methodology, data collection, writing the dissertation manual, dissertation defense. Triangulation was used to contrast and compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) with data obtained from faculty interviews. Member checking occurred to allow faculty to edit, delete, correct, or elaborate on the transcript data. The researcher also provided a summary of emergent themes associated with each faculty participant. Inter-rater reliability was also used to measure the percentage of agreement between two faculty members independent from the study.

Assumptions

According to Laerd (2017), when a researcher chooses to analyze data using an independent samples t-test, certain assumptions must be met. An independent samples t-test was used to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *math* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because the following assumptions were met: (a) a continuous dependent variable of math developmental standard scores (SS) existed within the data set, (b) the independent variable had two groups of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™, (c) independence of observations was evident in the data set, (d) there were no significant outliers in the two groups of six grade math students in terms of the developmental standard score (SS) on the math section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008), (e) the developmental standard score (SS) on the math section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) was normally distributed for the two groups of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™, and (f) the assumption of homogeneity of variances was met. The independent samples t-test was not used to conduct the analysis of the *computation* section to test the difference between the developmental standard score (SS) for the computation section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because there were significant outliers of developmental standard scores (SS) for the *computation* section.

Ethical Considerations

This study applied proper ethical standards. Institutions or respondents of the quantitative data collection and interviews were not identified in this study. The institutions were recognized as private Catholic schools in Florida. The researcher was the only individual to identify the participants by name, email, and phone number for follow-up concerns or questions. The researcher replaced the participants name, emails, and phone numbers with assigned numbers for anonymity. All notes and recordings from interviews and data collected from assessment results were stored on an external encrypted hard drive for three years. Any information from the Dissertation in Practice was not be linked to individual responses. The researcher also followed all policies and processes set by Creighton University's Institutional Review Board (IRB).

The IRB approval letter with the protocol number, the invitational letter, informed consent documents, authorization letters, and other confidentiality measure are included in the appendix. Please see Appendix A for a summary of the research participant's bill of rights.

Summary

This chapter included a section regarding the proposed study's purpose, aim, methodology, planned data collection, proposed instruments for data collection, participants, procedures, timeline, financial and legal issues, data analysis, leadership roles, ethical considerations. The proposed convergent parallel design will use Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores between 6th grade students and interview data to explain whether or not *Mathletics*™, supplemental digital math tool, improves student learning and teaching methods at three private, Catholic schools in Florida.

CHAPTER FOUR: FINDINGS AND THE EVIDENCE-BASED SOLUTION

Introduction

Improving mathematical performance in K-12 environments has become a major focus for educational institutions in the United States. Students in the U.S. are below average in math compared to other countries (PISA, 2012). In 2015, only 40% of 4th grade math students in the U.S. scored at proficient level and above on the National Assessment of Educational Progress (NAEP) assessments leaving 60% of students scoring at a basic or below basic level of math (The Nation's Report Card, 2015). According to the Nation's Report Card (2015), 4th grade students scoring at the basic and below basic level of mathematics show some evidence of performing simple computations. To score at a proficient level and above, students must have conceptual knowledge to solve real-world problems (The Nation's Report Card, 2015). Moreover, Tucker and Darling-Hammond (2014) suggested, based on evidence from a recent study, that other countries are outperforming the United States in math. The U.S. public and private school systems offers a variety of student assessment programs that are administered by individual state, local school districts, and private schools; therefore, not all students are provided the same math standardized tests to measure math proficiency (Michigan Department of Education, n.d., Florida Department of Education, n.d., Alabama Department of Education, n.d., & Archdiocesan of St. Louis, n.d.). Effective methods are needed to improve mathematical skills in the United States K-12 educational institutions (McCormick & Lucas, 2011). Based on the findings described in this chapter, strengthening the use of computer-enhanced math interventions is a beneficial approach to improving student performance. Furthermore, the findings of the research suggest that interactive digital media used in the K-12 classroom can enhance student learning and teaching methods (Murray & Olcese, 2011). Moreover, Ozel, et al., (2008) suggested that although the integration of technology yields positive results, effective implementation of technology in the math classroom is essential to student learning and teaching methods. This chapter presents the quantitative and qualitative analysis of the data of whether or not *Mathletics*™ improves student learning and teaching methods at three private, Catholic schools in Florida. The results of this convergent parallel mixed methods approach were to assist classroom teachers, school administrators, curriculum writers, and other school stakeholders in planning and implementing effective digital math tools in math classroom environments.

Purpose of the Study

The purpose of this convergent parallel mixed methods study was to determine whether *Mathletics*™ improved student learning and teaching methods at three private, Catholic schools in Florida. In the study, a quantitative research question addressed correlations of *Mathletics*™, a supplemental digital math tool, and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores with two sets of 6th grade students at three private, Catholic schools in Florida. One group of 6th graders at three Catholic schools in Florida received *Mathletics*™, while the comparison group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™. The 6th grade group of students that received *Mathletics*™ were students that have taken the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year after the implementation of *Mathletics*™ at their respective school and the comparison group of 6th grade learners were students that did not receive *Mathletics*™ and took the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) one academic school year prior to the implementation of *Mathletics*™ at their respective school. A standardized qualitative interview protocol was used to explore the perceived impact of *Mathletics*™, a supplemental digital math tool, on student learning and teaching methods. This convergent parallel mixed methods approach provided rich insight into the effectiveness and perceived strengths, and weaknesses of *Mathletics*™, and provided an understanding of how the findings will impact future leadership decisions by classroom teachers, administrators, and other stakeholders concerning the implementation of digital math tools in the math classroom. During the qualitative strand, the study targeted faculty implementing and utilizing *Mathletics*™ within their respective classrooms at three private, Catholic schools in Florida. School faculty was purposefully sampled for the qualitative phase due to their knowledge and experiences of integrating *Mathletics*™ into their math classrooms.

Aim of the Study

The aim of this Dissertation in Practice was to determine whether or not *Mathletics*™ improved *student learning* and *teaching methods* in the 6th grade math classroom and created evidence-based solutions for school leaders from the research findings.

Summary and Presentation of the Findings

Review of Methodology

Convergent parallel, mixed methods design was used in this study. The quantitative data included math and computation sections of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores. The study examined two sets of 6th grade students at three private, Catholic schools in Florida. The study also collected interview data from teachers (N=12) at three private, Catholic schools in Florida. Permission to use the Catholic schools for this study was granted from each principal of three private, Catholic schools in Florida. The principal of each Catholic school provided the researcher Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores of one group of 6th graders (N=127) at three Catholic schools in Florida that used *Mathletics*™ and a comparison group of 6th graders (N=112) at three

Catholic schools in Florida did not used *Mathletics*™. Table 1 illustrates a description of the school demographics.

Table 1

Catholic Enrollment School Demographics

School Code	Total Student	American Indian	Asian	Black	Hispanic	White	Unknown	F	M
S1	705	5	35	1	192	401	71	373	332
S2	181	1	7	6	15	139	13	85	96
S3	384	1	31	15	96	241		193	191

Note. American Indian includes Alaskan students. Asian includes Pacific Islander students. F indicates female students and M indicates male students.

Simultaneously, qualitative interview data was also collected from faculty at three private, Catholic schools in Florida in order to mutually corroborate the findings. In the qualitative strand, the researcher interviewed twelve participants implementing and utilizing a digital math tool within their respective classroom at three private, Catholic schools in Florida. The principal of each respective school invited eligible teachers (*N*=12) to participate in the interviews. School faculty were purposefully selected for the qualitative strand of the study and chosen by the principal of each school for having the most knowledge of the use of *Mathletics*™. The goal of this mixed methods study was to answer the following research questions:

Central Research Question

The central research question for this study was:

- Did the integration of interactive media such as *Mathletics*™ improve student learning and teaching methods in the 6th grade math classroom?

The research questions for the study are

Quantitative Research Question

For the quantitative phase of this study the guiding research question was:

- Did *Mathletics*™ improve student learning based on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores when comparing the achievement of 6th grade students who participated in *Mathletics*™ and students who did not participate in *Mathletics*™?

Qualitative Research Question

For the qualitative phase of this study the guiding research question was:

- What are faculty perceptions of whether or not *Mathletics*™ improves student learning and teaching methods?

The central research question included the congruity between archived assessment data and faculty perceptions of whether or not *Mathletics*™ improved student learning and teaching methods. The quantitative research question focused on whether or not there was a relationship between *Mathletics*™ and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores. The qualitative research question focused on teacher perceptions of whether or not *Mathletics*™ improved student learning and teaching methods.

Results for the Quantitative Question on *Mathletics*™

The study addressed the relationship of *Mathletics*™ and Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for 6th grade students at three private, Catholic schools in Florida. The data set consisted of 239 Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS). The range of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the math section from lowest to highest was 179 to 281. The range of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the computation section from lowest to highest was 160 to 298. For this study, the independent variables included 6th grade math students (*N*=112) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™ and the dependent variables included the developmental standard scores (SS) for the *math* section and *computation* section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008). The *math* and *computation* sections were analyzed separately during the study.

Math Section

An independent-samples t-test was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *math* section of 6th grade math students (*N*=112) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. The independent-samples t-test was used to determine if a statistically significant difference existed between the means of the *math* sections prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after approximately one year of the implementation of *Mathletics*™. The two sets of learners are comparable populations with similar demographics. The researcher collected a full set of data without any missing data, thus a randomization to balance the data set did not occur.

Computation Section

A Welch's test and a non-parametric Mann-Whitney U test was used to determine if there was a difference between the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because the independent samples t-test assumptions were not met and the assumptions of homogeneity of variances were violated. Based on the Leven's test, the assumptions of homogeneity of variances were violated.

A Welch's test in SPSS was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS), for the 6th grade math students (*N*=127) prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners (*N*=127) after the implementation of *Mathletics*™. A Mann-Whitney U test in SPSS was also conducted to compare the same data in order to support the original Welch's test. A Welch's test and a Mann-Whitney U test in SPSS was used rather than the independent samples t-test to test the difference between the developmental standard score (SS) for the *computation* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because the two sets of learner variances were unequal based on the Levene's test. The researcher collected a full set of data without any missing data, thus a randomization to balance the data set did not occur.

Math Section Assumptions

Certain assumptions must be met when a researcher chooses to analyze data using an independent samples t-test (Laerd, 2017). An independent-samples t-test was conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *math* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because the following assumptions were met: (a) a dependent variable was measured on a continuous scale, (b) the independent variable had two groups of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™, (c) there were different participants in the group that used *Mathletics*™ and the group that did not use *Mathletics*™, (d) there were no outliers in the two groups of six grade math students in terms of the developmental standard score (SS) on the math section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008), (e) the developmental standard score (SS) on the math section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) was normally distributed, according to histograms for the two groups of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™, and (f) the assumption of homogeneity of variances was met, as assessed by Levene's test for equality of variances ($p = .905$).

Computation Section Assumptions

The independent samples t-test was not used to conduct the analysis of the *computation* section to test the difference between the developmental standard score (SS) for the computation section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because there were significant outliers shown using boxplots of developmental standard scores (SS) for the *computation* section and assumption of homogeneity of variances was violated, as assessed by Levene's test for equality of variances ($p = .016$). Results indicated a statistically significant difference in medians ($p < .05$), thus, the null hypothesis was rejected, and the researcher has ruled out using the independent samples t-test for the *computation* section. Figure 1 provides an illustration of the significant outliers shown using boxplots of the developmental standard scores (SS) for the computation section.

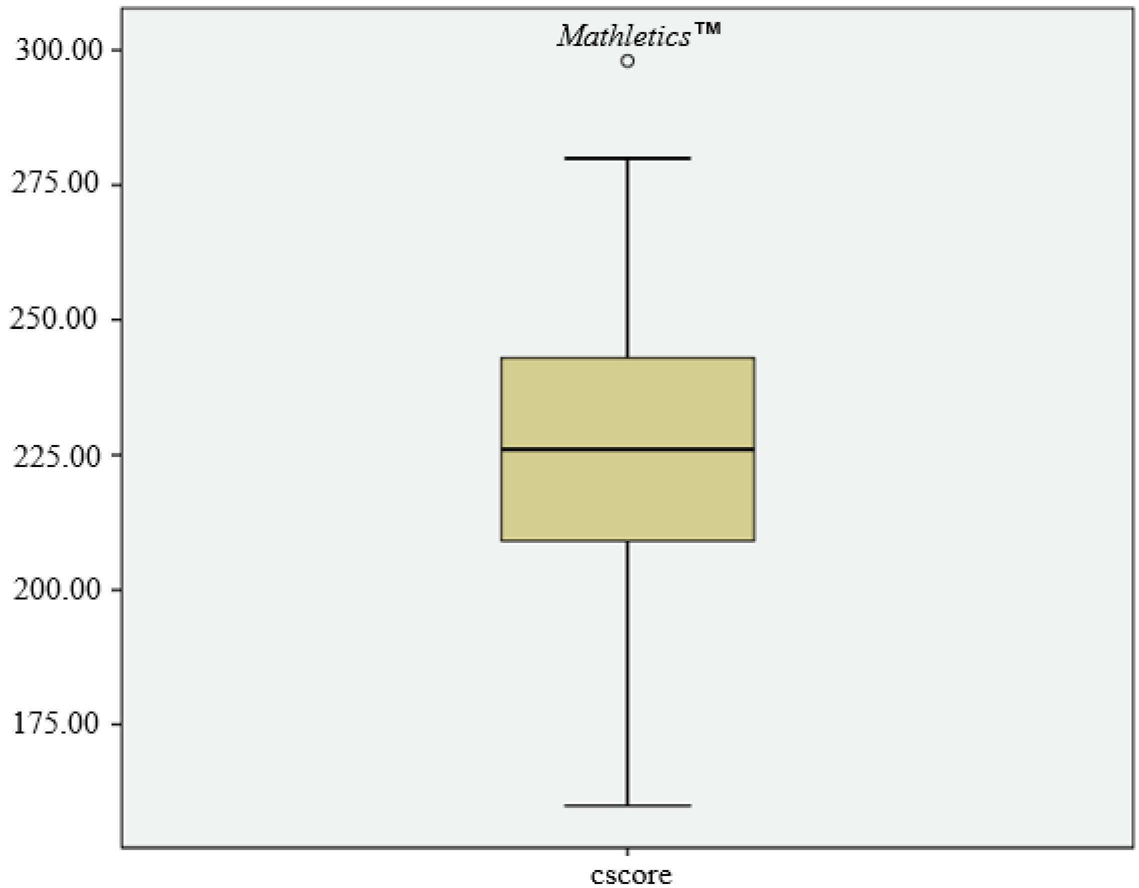


Figure. 1. Significant outliers of the computation standard developmental score using boxplot in SPSS.

Alternative to the independent samples t-test, a Welch's parametric test in SPSS was used to test the computation section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because data failed the assumptions of the independent samples t-test. A Mann-Whitney U test was also conducted to compare Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics™* because the following assumptions were met: (a) a continuous dependent variable of math developmental standard scores (SS) existed within the data set, (b) the independent variable had two groups of 6th grade math students prior to the implementation of *Mathletics™* and 6th grade math students of a different set of learners after the implementation of *Mathletics™*, (c) there were different participants in the group that used *Mathletics™* and the group that did not use *Mathletics™*, (d) the distribution of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the computation section of 6th grade math students prior to the implementation of *Mathletics™* and 6th grade math students of a different set of learners after the implementation of *Mathletics™* had the same shape as shown in figure 2.

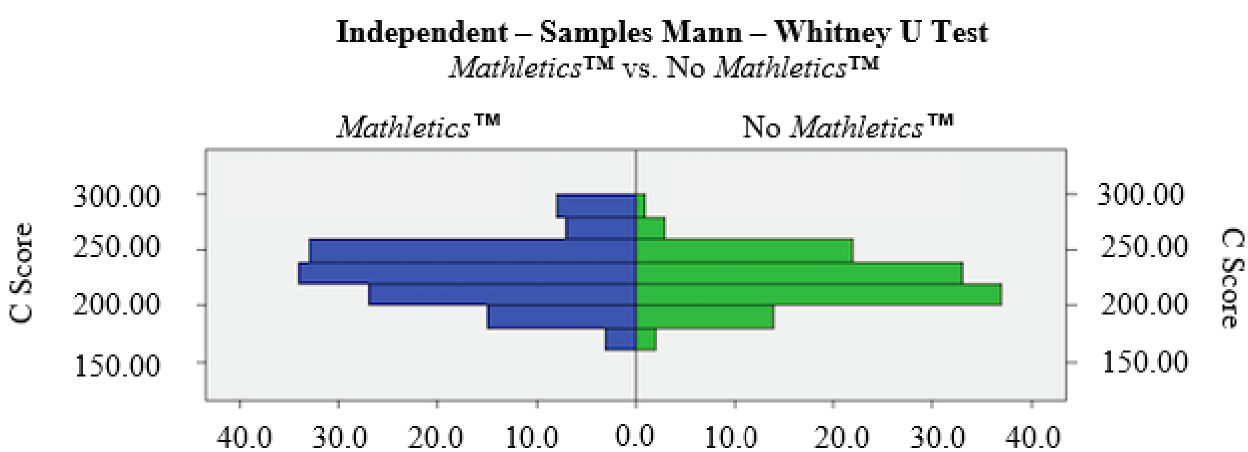


Figure. 2. Similarly shaped distributions of the *computation* section in SPSS.

Similarly shaped distributions were evident, as shown in Figure 2, of the *computation* section of the developmental standard score for the two groups of 6th grade math students prior to the implementation of *Mathletics™* and 6th grade math students of a different set of learners after the implementation of *Mathletics™*. Moreover, the mean rank of the 6th grade math students that used *Mathletics™* was higher than the mean rank of the 6th grade group of students that did not use *Mathletics*™. A Welch's and Mann-Whitney U test in SPSS were used to compare the medians of the *computation* section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™.

Quantitative Research Question

Did Mathletics™ improve student learning based on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores when comparing the achievement of 6th grade students who participated in Mathletics™ and students who did not participate in Mathletics™?

Math Section Results

As shown in Table 2, an independent samples t-test indicated there was not a statistically significant difference in the developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the *math* sections of 6th grade math students prior to the implementation of *Mathletics*™ (M = 226.10, SD = 22.76) and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ (M = 226, 95% CI [-10.06, 1.55], $t(238) = -1.44$, p = 0.150.

Table 2

Mean Differences between Mathletics™ vs. No Mathletics™ Math Section

Mathletics vs. No Mathletics	*N*	*M*	*SD*	*SEM*	*t*	*df*	*Sig. (2-tailed)*
No Mathletics	112	226.10	22.76	2.15	-1.444	238	0.15
Mathletics	128	230.35	22.77	2.01			

Results show that 6th grade students at three private, Catholic schools in Florida that used *Mathletics*™ did not show a statistically significant difference in the developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the math sections of 6th grade math. A Cohen's D effect size was not conducted to determine the magnitude of the comparison of Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) for the *math* sections of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ because there was not a statistically significant difference between the scores. Due to no statistically significant difference, there was no need to quantify the difference between the two groups.

Computation Section Results

A Welch's test indicated the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* sections of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ was greater for 6th grade math students after the implementation of *Mathletics*™ than for 6th grade math students prior to the use of *Mathletics*™. There were 112 6th grade students prior to the implementation of *Mathletics*™ and 127 6th grade students of a different set of learners after the implementation of *Mathletics*™. As assessed by the inspection of a boxplot, there were outliers. A lack of homogeneity of variance was found between the variances, as assessed by Levene's test for equality of variances ($p = .016$). The Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* sections of 6th grade math students were higher for students that used

Mathletics™ (M = 230.36, SD = 26.64) than students that did not use *Mathletics*™ (M = 222.14, SD = 22.09). The Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* sections of 6th grade math students was – 8.22, 95 % CI [- 14.43 to - 2.01] higher for students that used *Mathletics*™ than students that did not use *Mathletics*™ (M = 222.14, SD = 22.09). There was a statistically significant difference in Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) of the *computation* sections between 6th grade students that received *Mathletics*™ than students that did not use *Mathletics*™, with 6th grade students that received *Mathletics*™ scoring higher than 6th grade students that did not use *Mathletics*™, M = 230.36, 95 % CI [- 14.43 to - 2.01], t(- 236.14) = -2.61, p = .010. The Welch's test indicated that scores for the *computation* sections were 8 points higher for students who used *Mathletics*™ than those that did not use *Mathletics*™. There was a statistically significant difference between means (p < .010), and therefore, the null hypothesis was rejected and the alternative hypothesis was accepted. As shown in Table 3, Welch's test indicated there was a statistically significant difference in the developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the *computation* sections of 6th grade math students prior to the implementation of *Mathletics*™.

Table 3

Mean Differences between Mathletics™ vs. No Mathletics™ Computation Section

Mathletics vs. No Mathletics	*N*	*M*	*SD*	*SEM*	*t*	*df*	*Sig. (2-tailed)*
No Mathletics	112	222.14	22.09	2.09	-2.606	236.14	0.010
Mathletics	127	230.36	26.64	2.36			

A Mann-Whitney U test indicated the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the *computation* sections of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™ was greater for 6th grade math students after the implementation (N = 127) of *Mathletics*™ (Mdn = 129.80) than for 6th grade math students prior (N = 112) to the use of *Mathletics*™ (Mdn = 108.89), U= 5867.5, p= .019. The Mann-Whitney U test was used to measure the difference in medians between 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™. Median *computation developmental scores* for participants after the implementation of *Mathletics*™ (129.80) versus participants' *computational developmental scores* of participants prior to the implementation of *Mathletics*™ (108.89) were statistically significantly different, U = 5867.5, z = - 2.337, r = -.207, p = .019. As shown in Table 4, a Mann-Whitney U test in SPSS indicated a statistically significant difference between the medians of the two groups of 6th grade groups.

Table 4

Student Learning Differences on Mathletics™ vs. No Mathletics™ Computation Section

Mathletics vs. No Mathletics	N	Mdn	U	z	p
No Mathletics	112	108.89	5867.5	2.34	0.019
Mathletics	127	129.80			

An effect size was conducted to determine the magnitude of the comparison of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard score (SS) for the computation section of 6th grade math students prior to the implementation of *Mathletics*™ and 6th grade math students of a different set of learners after the implementation of *Mathletics*™. The result of the Cohen's d effect size of Mann-Whitney's U test was in between the standard value of small and medium (r = -.207). Cohen (1988) argued effect sizes as "small, d=.2," "medium, d=.5," and "large, d=.8" (p. 25). The result of the Cohen's d test of -.207 is of little importance. The results show that 6th grade students at three private, Catholic schools in Florida that received *Mathletics*™ had improved developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the *computation* sections of 6th grade math, therefore indicating a meaningful and substantive impact to student learning and teaching methods in private, Catholic school math classes.

Results for Questions Regarding Perceptions about *Mathletics*™

The study explored twelve faculty perceptions of the impact of *Mathletics*™, a supplemental digital math tool, on student learning and teaching methods at three private, Catholic schools in Florida. Qualitative interview data were collected in order to mutually corroborate or refute the quantitative findings. Triangulation was used to establish validity of the research findings through multiple perspectives: member checking and utilization of multiple methodologies (Creswell, 2013). During the qualitative strand, the researcher included participants implementing and utilizing *Mathletics*™ within their respective math classrooms. School faculty were *purposefully selected* by the principal of each school for the qualitative phase of the study and were chosen for having the most knowledge of the use of *Mathletics*™ experience in the math classroom. The purpose of collecting interview data was to develop a more complete understanding of the extent to which *Mathletics*™ impacted student learning and teaching methods based on faculty perceptions (Creswell & Plano Clark, 2011).

The qualitative data set included twelve one-on-one interviews with faculty. Faculty participants had between 5 to 20 years of teaching experiences. All participants used *Mathletics*™ in their respective classrooms for at least one academic school year. Interview responses were received from teachers in private, Catholic school one (N = 4), private, Catholic school two (N = 4), and private Catholic school three (N = 4). The median number of years of service in the role as a teacher in the Catholic school environment was 9.5 years. Table 5 provides a demographic description of the participating interviewees.

Table 5

Demographic Descriptions of Participants

Teacher Code	Teacher Gender	School Code	Number of Years in Role	Number of Years Using *Mathletics*™
T1	Female	S1	20	2nd Year
T2	Female	S1	10	2nd Year
T3	Male	S1	10	2nd Year
T4	Female	S1	6	2nd Year
T5	Female	S2	17	2nd Year
T6	Female	S2	8	2nd Year
T7	Female	S2	14	1+ Years
T8	Female	S2	9	2nd Year
T9	Female	S3	8	2nd Year
T10	Female	S3	17	1 Year
T11	Female	S3	5	2nd Year
T12	Female	S3	7	2nd Year

Maximum variation sampling, a purposeful sampling strategy was used in order to gain insightful perceptions from a variety of angles within the three private, Catholic schools in Florida (Creswell, 2013). Faculty respondents taught 1st grade to 6th grade. Teacher respondents and grade levels taught are illustrated in Table 6 below.

Table 6

Teacher Respondent and Grade Level Taught

Teacher	Grade Level
Teacher Respondent T1	6th Grade
Teacher Respondent T2	4th Grade
Teacher Respondent T3	5th Grade
Teacher Respondent T4	3rd Grade
Teacher Respondent T5	3rd Grade
Teacher Respondent T6	1st Grade
Teacher Respondent T7	4th Grade
Teacher Respondent T8	5th Grade
Teacher Respondent T9	5th Grade
Teacher Respondent T10	6th Grade
Teacher Respondent T11	2nd Grade
Teacher Respondent T12	3rd Grade

The use of a digital voice recorder and hand written notes were used to collect, save, and archive the raw interview data. After twelve interviews were externally transcribed, the researcher read the data twice to identify concepts and categories. The researcher recorded and coded the data from each interview. Open coding was used during the first phase of coding. Common concepts and categories were identified across the sample of interview descriptions (Creswell, 2013). During open coding, the researcher identified distinct concepts and categories in the data by breaking down the data into master headings and subheadings. Dedoose qualitative analysis software was used to highlight and create a list of distinct concepts and categories.

Responses to the interview questions were also coded manually in order to retrieve the perceived impact of student learning and teaching methods of supplementary digital math tools in the math classroom for private, Catholic schools in Florida. During the first phase of coding, the researcher categorized the interview data by using open coding (Creswell, 2013). Emergent themes from the open-coding process included *teachers seeking more data, extended practice, and enhancements to learning.*

During the second phase of qualitative analysis, axial coding was used to highlight significant themes explored and found within the interviews data and confirm that the emergent concepts and categories accurately represented the interview responses (Creswell, 2013). During axial coding, the researcher reread the interview text within the Dedoose software to identify relationships among the emergent concepts and categories. The researcher developed a master coding list that included master headings and subheadings.

During the final step, selective coding was used to explore relationships and connections among the major categories and emergent concepts based on the open and axial coding process. During the selective coding process, the researcher used Dedoose software to reread the interview text in order to selective code data that related to the major categories and emergent concepts. Throughout the coding processes, memo writing was conducted to track the researcher's thoughts and ideas (Creswell, 2013). The researcher used handwritten notes captured from qualitative interviews and then entered the memo notes taken from the qualitative interviews into the Dedoose software. The researcher reread the memo notes to identify potential relationships and connections to the emergent categories and associated concepts found during the open, axial, and selective coding process.

Member checking was utilized to act as a quality control process to strengthen the validity of the interview data from faculty (Creswell, 2011). The researcher sent each interview participant a copy of their transcript to provide them the opportunity to edit, delete, correct, or elaborate the transcript data. The researcher also provided each interview participant a summary of the emergent themes derived from the coding process related to each individual respondent. It is assumed that no response from the interview participant indicated that corrections are not necessary.

The inter-rater reliability procedure was also used to ensure reliability of the interview data (Creswell, 2011). During the inter-rater reliability procedure, the researcher provided quotes from interview participants and a summary of the emergent themes to two raters independent of the study. This process attempted to measure the percentage of agreement between the two raters.

Qualitative Research Question

What are faculty perceptions of whether or not Mathletics™ improves student learning and teaching methods?

The qualitative research question explored faculty perceptions of whether or not *Mathletics*™ improves student learning and teaching methods. Twelve faculty from three private, Catholic schools identified experiences that contributed to the following seven significant emergent themes of whether or not *Mathletics*™ improves student learning and teaching methods. These seven emergent themes included the following: *Interactive Media Usage in Math Instruction, Student Motivation and Engagement in Learning, Utilization of Data to Inform Instruction, Extended Practice and Reinforcement, Professional Development, Meeting Expected Math Skills and Standards, and Principles and Methods for Math Instruction.* The qualitative themes reflect both student learning and teaching methods. The results of the seven emergent themes have master heading with subsequent subheadings. Table 7 describes the seven emergent themes and associated concepts:

Table 7

Emergent Themes of Student Learning and Teaching Methods

Emergent Themes	Associated Concepts
Interactive Media Usage in Math Instruction	Engagement, student participation, online collaboration, competition, student excitement, electronic games, student competition, log on issues, availability of computers, usability, versatility.
Student Motivation and Engagement in Learning	Student excitement about math, fun, motivated to learn, challenging, practice, empowers participation, student competition.
Utilization of Data to Inform Instruction	Tracking math trends, monitoring student progress, reporting math results, effective reporting tools, additional reporting needed.
Extended Practice, Repetition, and Reinforcement	Extra practice, repetition, individualized learning, supplements existing instruction, added resource, extension to existing learning.
Professional Development	Additional teacher training, hands on practice, exploring the tool, becoming more prepared.
Alignment of Core Curriculum and Expected Math Standards	Aligns with math curriculum, Common Core Standards.
Principles and Methods for Math Instruction	Differentiated learning avenues, Individualized learning opportunities, instant feedback.

Theme One: Interactive Media Usage in Math Instruction

As shown in table 8, emergent theme one includes a master heading with three subheadings. The following theme describes each major theme and subtheme and provides relevant quotations from faculty participants that illustrate and support the theme and subthemes. Table 8 depicts the master heading and subheadings for emergent theme one:

Table 8

Emergent Theme One

Master Heading	Subheadings
Interactive Media in Math Instruction	Technology was a benefit to classroom instruction.
	Log on and Internet issues.
	Availability of computers and tablets.
	Usability and versatility.

Technology was a benefit to classroom instruction.

All twelve faculty participants described *Mathletics*™ as average or above average in terms of student learning and teaching methods. Most faculty respondents remarked that technology, specifically interactive digital media, added to math instruction was a benefit. Nine of the twelve or 75% of faculty respondents reflected that the use of tablet computers, supplemental digital tools, and online student collaboration platforms all lead to a positive result in student learning. Faculty respondents emphasized that effective integration, particularly used as a supplemental digital tool that offers a variety of methods for learning math, *Mathletics*™ yielded positive results of engagement, participation, competition, and collaboration. Direct quotes from teacher respondents emphasized:

- I think some students… they open their mind more when it is on the computer because they are so computer literate and surrounded by technology in this generation (Teacher Participant T9).
- In my opinion if it's utilized properly or at least to the extent that it could – and I – and honestly I could probably utilize it even more than I do. I definitely feel like it's positive because again you have a wide variety of things you can assign and if you want to go back and actually print out lessons you can go to that section and print lessons for kids to work on. Being that we have a large class sizes it lets me have again another tool where they're not sitting waiting on me or getting into mischief because they know the expectation is to finish what they're on and then go online and work on what they've been assigned and then if they finish, they know they can go on to live math or they can watch the videos or they can do one of the other activities, so for me it's been very helpful… (Teacher Participant T1).
- I think it would improve student learning in the classroom per concept or per subject just from giving the students a little more varied approach to learning, and instead of simply paper and pencil or lecture learning, it does give them another option or another way to absorb the material (Teacher Participant T3).
- The electronics is preferred by them and it's … just another tool that I can use to keep them engaged (Teacher Participant T8).
- There is a feature called "Live *Mathletics*™" where they go in and they can compete with people from all over the world … so it's exciting when the flags come up from all over the World … so It's exciting (Teacher Participant T5).

- I believe it is a positive tool. It has very animated. It has a lot of games for the students and obviously, being an electronic based game approach, the students tend to enjoy it (Teacher participant T4).
- I think they are excited to use the computers at any time really, so when they get to use it for math and it's something different than me teaching them how to do something or them having to write about math problems … they get very excited (Teacher Participant T2).
- …If you just asked your kids to… study their math facts at home, they are not going to do that. You know, but they could go in and they win certain things to decorate their Avatar where they get certain prizes… it is just because of this program that they are doing these things and that's great; great incentives (Teacher Participant T6).
- I think kids in general think anything with technology; it's just much cooler. So, all of sudden math is cool and a lot of times it's the same exact math that you did in your workbook or you did in an activity with me or you were playing a game together with your friends, but it is the same exact math (Teacher Participant T12).

Log on and Internet issues.

Some faculty respondents also noted various technology issues that result in failure to log on to *Mathletics*™ in the classroom and at home. Six of twelve or 50% of faculty respondents noted having technology issues when attempting to use *Mathletics*™ in the classroom. Problems included students forgetting their password and Internet log on issues. Direct quotes from faculty respondents cautioned:

- When the servers are working, it's all great, but sometimes they can't all log in at once or logs them off because there's too much of an overload. I don't have enough computers for everybody to be doing it at once, so there's always little bit of a battle there (Teacher Participant T8).

- We have some kids that have a hard time getting on … when they go to the sign in, they might leave out a number or they might leave out the "dash" in their password … (Teacher Participant T6).
- The challenges I think would be, you know, sometimes the connection. You know if we have problems with the connection in the classroom; that makes it a little more difficult… most of the students do have computers at home or have some electronic tool that they can actually access it, but if they are having problems; they even sent me messages… our system was down last night… (Teacher Participant T4).
- It's mostly technology wise with the student netbooks whether they can't log on the Internet for whatever reason. There is lots of sound with it so sometimes the sound will go off when the kids don't realize the sound is on, so then that distracts other people… it's mostly just the internet issues, and sometimes the kids can't get on at home, and then also the logging in they gave them. Their username and password is like the passwords are kind of crazy so sometimes they have a hard time remembering that so that makes it difficult too for them to log in (Teacher Participant T2).
- The challenges are sometimes the Internet does not work … Teacher Participant T9).
- At the beginning of the year… they offered other password or lost it… (Teacher Participant T11).

Availability of computers and tablets.

A few faculty respondents highlighted having limited access to classroom computers or tablets when attempting to utilize *Mathletics*™ in the classroom. Three of twelve or 25% of faculty respondents disclosed during the interviews that computer or tablet availability in the classroom was an issue. It was also noted that there is a lack of computer availability when a student gets home. Therefore, effective classroom planning to integrate *Mathletics*™ is essential to learner access. Direct quotes from faculty respondents cautioned the need for additional classroom computers and tablets:

- … when you share 35 computers with the other class so you have to plan it out, and it's not as easy just to like teach a lesson and then have them practice on *Mathletics*™ all in the same class period (Teacher Participant T2).
- It seems to be easier to use on a computer than on an iPad. So, it would be nice to have more computer access, because right now, I only have 3 computers in my classroom that are up and running, but I have 6 iPads (Teacher Participant T6).
- … they definitely get distracted sometimes like they are waiting, waiting, and waiting for their turn; you know like "ah, I want to be on there, I want to be on that computer," so, I only have four computers in my classroom… (Teacher Participant T12).

Usability and versatility.

Most faculty respondents emphasized at least one weakness and drawback to *Mathletics*™. Eleven of 12 faculty respondents highlighted a weakness or drawback to using *Mathletics*™ in their math classroom including the usability and versatility of the digital tool. Examples of usability and versatility of the digital tool include: offering features to help enhance student learning, providing an easy way for students and faculty to access various parts of the portal, and providing ways for student use outside of the classroom. Direct quotes from the interviews that supported this subheading within this theme included the following:

- … when they enter in the answer, sometimes the numbers don't go in correctly, so then you have to go back and I have to show them how to like click on the box and make sure it goes in correctly…when you assign like a whole class something and then you go back to the home screen, you can't see what you have assigned them. You have to remember what exact standard it was under and then you have to go on to the sub standard and then you can see it… if a kids wants to redo it then I have to remember okay where was it, to go back to, to get to that… I feel like there is on the front home screen there is too many boxes and options when really all you really need to go into…but there is too many boxes that aren't really helpful (Teacher Participant T2).
- Actually that would be helpful if it was more universal for – it's nothing about *Mathletics*™ but if the terminology across the board was more universal then what – no matter what textbook you're in, it would be easier to find the topic that you are looking to teach… One of the things I would change is when I search a topic to assign to the kids It's – sometimes it's very specific. I would like it if, and I know one of the things I was trying to find some things on Expanded Form using powers of ten and I couldn't find anything on that topic… (Teacher Participant T1).
- Make it easier for the teacher to understand it (Teacher T11).
- I would have it more familiar with iPads where you could actually write on your iPad and then type in your answer… It is a little too cartoon based. You know, it is a little childish… I just think it doesn't reach the middle school level quite as well (Teacher Participant T10).

- I would let more assignments be made at a time because I run into where my slower student have so many assignments to make up and my faster ones are done and then I end up trying to assign more but it won't let me… (Teacher Participant T9).
- I would like to be able to view what assignments, because right now, I am just looking at the standard and I am just, you know, like to get to the topic. I would like to be able to see a sample of the problems that they are going to get… (Teacher Participant T6).
- For us to be able to see exactly if the students to be able to work somewhat the problems. You know, when they get stuck in a problem, exactly what is that they are doing in order for us to be able to know that, so we can help them… (Teacher Participant T4).
- It's not as versatile a program as I had been led to believe. You pretty much get what they give you and I can't adjust based on my needs or basically based on the students' needs to specific items rather than the whole general topic…If they were having trouble with decimal places, place value, I would have to basically give them the whole adding decimals and subtracting decimals palette; I can't just pull out a few problems here and there or one specific section and say "I just want you to do these 10." You have to do the whole batch whatever they have; they have broken it down into. I can't pull out sections… Pretty much the program is the program and you can't adapt it to the classroom needs, as much as I would like. What I was led to believe with *Mathletics*™ was presented was that I could pick and choose what I wanted to create my own assessments, and that's not the case… (Teacher Participant T3).
- I noticed that there a lot of activities that are not mental math and there is no place on the screen for them to have room to work like I have seen other programs where they can,

draw on the screen and draw out the problems and write things… (Teacher Participant T12).

- Maybe synthesizing of different concepts, they don't see clearly that was they learn two weeks ago is being applied in a current problem unless it's – at this age unless it's pointed out to them… (Teacher Participant T8).
- The only problem I've really run into is kids going and doing things they haven't been taught yet (Teacher Participant T7).
- They sometimes approach it as a game instead of serious work. I think when they get their score at the end of the *Mathletics*™ segment, and may be they didn't do as well, it doesn't affect them as much as if I handed them a paper that had a 30% on it or something… (Teacher Participant T9).

Theme Two: Student Motivation and Engagement in Learning

As shown in table 9, emergent theme two includes a master heading with four subheadings. The following theme describes each major theme and subheadings and provides relevant quotations from faculty participants that illustrate and support the theme and subheadings. Table 9 depicts the thematic heading and subheadings for emergent theme two.

Table 9

Emergent Theme Two

Master Heading	Subheadings
Student Motivation and Engagement in Learning	Student excitement when using a digital math tool.
	Fun and exciting way to learn math.
	Rewards and incentives.
	Competition and collaboration.

Student excitement when using a digital math tool.

The majority of faculty respondents expressed that *Mathletics*™ benefits the math classroom because the students get excited to use the math tool. Ten of twelve or 83% of faculty respondents emphasized that students are enthusiastic about learning math when using *Mathletics*™ in the classroom. Practicing basic math functions utilizing *Mathletics*™ that required addition, subtraction, multiplication, and division motivates learning. A faculty respondent emphasized "the biggest benefit I noticed is that they are excited to do math and especially their basic math facts/functions" (Teacher Participant T12). Direct quotes from other faculty respondents about student motivation and engagement when using *Mathletics*™ in the classroom include:

- …get the kids active in math and have a little bit more enthusiasm toward it (Teacher Participant T9).

- …if you just asked your kids to, you know, study their math facts at home, they are not going to do that. You know, but they could go in and they win certain things to decorate their Avatar where they get certain prizes… (Teacher Participant T6).
- …they are looking forward and are ready to actually be able to get into *Mathletics*™, because they know the games that are in there, even though they may be challenging sometimes because of, you know, some of the concepts that they are learning or they are practicing is still through games… (Teacher Participant T4).
- … in general it's positive thing and I mean I don't get groans when I say "go onto *Mathletics*™", you know, we are going to do this today, so and in general sense, it's definitely a positive atmosphere… (Teacher Participant T1).
- I would say that it's useful, that the kids really enjoy it, make it exciting for the kids to learn math…They love it. They like it. I think they are excited to use the computers at any time really, so when they get to use it for math and it's something different than me teaching them how to do something or them having to write about math problems… (Teacher Participant T2).
- The motivation of it helps (Teacher Participant T11).
- It's another way to engage the students… the electronics is preferred by them and it's, you know it's just another tool that I can use to keep them engaged (Teacher Participant T8).
- The kids got excited about it (Teacher Participant T7).
- What I know with my kids is that they will literally fight with each other to do *Mathletics*™… they are so excited to be assigned and we alternate back between the assigned lessons (Teacher Participant T12).

- When the rotation is that they're on the computers doing *Mathletics*™ they are always happy if their group goes there first (Teacher Participant T8).

Fun and exciting way to learn math.

Several faculty respondents expressed that *Mathletics*™ is a fun and exciting way for students to learn math**.** Five of 12 or 42% of faculty respondents reflected that the use of *Mathletics*™ in the classroom helped students have fun while learning math. Providing engaging avenues to learn, math helps the students get excited and stay motivated to practice math. The faculty noted there are positive results in student learning because of students using *Mathletics*™. Direct quotes from faculty respondents include:

- They like it. They really like it, all of them and I say that from feedback I have gotten from parents and the fact that they are doing it. If one of their other classmates is on the computer, they can challenge them at home and they really like doing that (Teacher T6).
- Mathletics gives them opportunity to practice in a fun way, so they are more open and positive to math in general… (Teacher Participant T5).
- Fun as in interesting and challenging, so they want to do it (Teacher Participant T11).
- It's on the computer and it is fun (Teacher Participant T9).

Mathletics™ as a supplemental resource for teachers to assign in the math classroom led faculty to the impression that it gets students excited to learn math. A teacher reflected that when students calculate math problems with a fun resource that is utilized by a computer, as opposed to traditional methods using paper and pencil, the digital resource could have positive results on student learning. A teacher added:

> I would say that it does provide good impact on the student learning just because it provides that extra resource for the kids to practice in a fun way. That's on the computer

so that they can see it that way, it's not just working it out in a copybook just doing problems (Teacher T2).

Rewards and incentives.

Student rewards and incentives were emphasized in many faculty responses. Six of twelve faculty respondents or 50% highlighted rewards and incentives as a benefit to using *Mathletics*™**.** Faculty implied that students become motivated and encouraged to learn math when students receive rewards and incentives for math achievement. The use of points and certificates when math achievement is demonstrated, acknowledges the students' efforts. "It is positive because it gives students an empowerment and when they start seeing their scores like this and then they get certificates, they get medals, and I recognize it" (Teacher T4). A teacher also advised to make *Mathletics*™ fun by providing rewards and incentives to help motivate students. "Advice would be to use it as often as possible. Make it a center and make it fun. Give them rewards or incentives to do it" (Teacher Participant T11). Direct quotes from faculty respondents that emphasized rewards and incentives when using *Mathletics*™ in the classroom include:

- It's something that I can use that gives kids the incentive to learn and want to learn math… (Teacher Participant T2).
- It is just because of this program that they are doing these things and that's great; great incentives, yes (Teacher Participant T6).
- They see, they speak, "I have earned this many points" right on the home screen and then at the top it will say "today, I have earned…" It will tell them how many they have earned that day, the week, and it is kind of, I think, you know, this thermometer type things, where it is going up, up… (Teacher Participant T5).

- I think they like it. You know, especially the ones that have really taken off with it they – they like that they get the reward of being able to do live math or the ones that are struggling but are interested, you know, they like to do it too (Teacher Participant T1).

Competition and collaboration.

Faculty respondents elaborated that students enjoy competition and collaboration that *Mathletics*™ offers in the classroom and at home with other students. Eight of twelve or 67% of faculty respondents acknowledged that students were excited about competition and online collaboration. Students are able to compete with friends and students from all over the world. Faculty respondents identified experiences that led them to think that student enjoy competition and collaboration with a digital online tool. "…it gives you a breakdown of the students and what country they are from… and what schools are the ones that are playing. So, it is a great tool for the students to see and obviously we also live in a very competitive world…" (Teacher Participant T4). Direct quotes from the interviews that supported this subheading within this theme included the following:

- When they did the "World Competition," the second grade, like we were able to get on the top 10, so that was great, they were excited about that… They like to challenge each other, so it helps because they want to beat the other person… (Teacher Participant T11).
- Oh they use it… when they're doing the live *Mathletics*™ they love that, that they're talking to each other and figuring out who's on at what time (Teacher Participant T7).
- If one of their other classmates are on the computer, they can challenge them at home and they really like doing that… they like it. They definitely like it and the competition against each other is priceless and again they can do that from home (Teacher Participant T6).

- Even if they have the assignments, they do them and then they get to challenge their friends…challenging each other, which that's their favorite part… (Teacher Participant T2).
- …they literally fight with each other to do *Mathletics*™… (Teacher Participant T12).
- Most of them just like to challenge each other live (Teacher Participant T8).
- …so it's exciting when the flags come up from all over the World and they "oh, the person from Japan beat me by 1"… (Teacher Participant T5).

Theme Three: Utilization of Data to Inform Instruction

The following theme describes each major theme and subtheme and provides major quotations from faculty participants that illustrate and support the theme and subthemes. Table 10 depicts the master heading and subheadings for emergent theme three:

Table 10

Emergent Theme Three

Master Heading	Subheadings
Utilization of Data to Inform Instruction	Trend tracking through reporting for effective analysis of student learning.
	Iowa Test of Basic Skills™ (Riverside Publishing, 2008) performance after the use of *Mathletics*™.

Trend tracking through reporting for effective analysis of student learning.

Several faculty respondents revealed the need to be able to track trends and student achievement through effective reporting tools. Seven of twelve or 58% of faculty respondents emphasized that viewing reporting and results helped them to become more successful analysts of math learning. Faculty respondents also highlighted the need for additional reporting in order to become more effective analysts of student math achievement, and to be able to guide students when they need additional help. “I would like it if they had a wider variety of reports” (Teacher Participant T1).

The following excerpts were provided from faculty who thought the utilization of data to inform instruction was essential to the student learning and teaching methods. Direct quotes from the interviewees that supported this theme included the following:

- … as educators we have to see that in and obviously looking at numbers and everything else, we have to sit one-on one with those students and be able to address those and try to help them see that…we need to probably sit down and look at the results from *Mathletics*™, look at the bigger picture and then pull from that and really, really address those areas that the students may need them most. For the future, I think what I will do enhance the program is to be able to monitor a little bit better the student achievement. Some of their reports are fairly good as far as obviously providing you details, but I fell that we should have a little bit better breakdown when it comes to exactly what is that we need to assess the students (Teacher Participant T4).
- I think it makes you more aware of your standards, you know, and it helps … when you are seeing a report and you are seeing like a lot of the class is scoring low on a particular standard, you know that is something that you really need to go back and work on. So, it is a good reference (Teacher Participant T6).
- …I have to know what I'm doing with it too, and I don't own that, I don't completely get it all. I've gone through and looked at the different reports I can have and I can see their time spent and their problems that are right or not right, but what do I do with all of that?

There's where I need to – I need someone to sit with me and give me more (Teacher Participant T8).

- So when you can look at the results page and it shows you like a bar that says they did this many correctly and then they did this many. I would like to be able to have more of a report that is more specific and that I cold print so that I could give it to a parent… I would like to see a wider variety of reports… (Teacher Participant T1).
- I love the reports yeah I love the reports I get. I love how detailed they are, and I think it's … (Teacher Participant T7).
- …we do some analysis of it and we certainly want the scores to be good, but I don't know that we have really analyzed between this is when we started *Mathletics*™ and this is when we didn't do *Mathletics*™ (Teacher Participant T9).
- Check the results because like with any assessment if you give it and you don't bother to see how they are going through with things, you are not going to be as effective. So I definitely do make it a priority to go through on a regular basis, look at the results of things, reassign things, when they need to, which is a feature that I love; that you can look back and say, "Oh, we definitely need to do that again" (Teacher Participant T12).

Iowa Test of Basic Skills™ (Riverside Publishing, 2008) performance after the use of *Mathletics*™.

Many faculty respondents reported they were not sure how their students performed on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) after the students used *Mathletics*™. Seven of 12 or 58% of faculty respondents couldn't answer whether or not they thought that the use of *Mathletics*™ would improve Iowa Test of Basic Skills™ (Riverside Publishing, 2008). Faculty respondents elaborated that they were not sure if an increase or decrease in Iowa Test of

Basic Skills™ (Riverside Publishing, 2008) were directly related to the use of *Mathletics*™.

Direct quotes from the interviewees that supported this theme included the following:

- I don't honestly know if there's a correlation (Teacher Participant T1).
- I don't know. Probably, it depends on what you are talking about, but the last one, they improved. I don't know if it was based on *Mathletics*™… (Teacher Participant T2).
- I don't know… without that data in front of me, I don't know (Teacher Participant T5).
- It's hard, it's … hard to say right now because we really started using it just like now (Teacher Participant T7).
- That's hard to say, because I teach different group of kids each year. I would hope that it improved them, but I honestly statistically how it looked; I am a math teacher, so I would like to crunch numbers… (Teacher Participant T9).
- I think there is an improvement (Teacher Participant T10).
- We didn't use it very much last year just because we were starting to and the kids were getting used to it, so I am not sure if how well it affected it (Teacher Participant T11).

Faculty respondents also recognized increases and decreases on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) after the students used *Mathletics*™. Three of 12 or 25% of faculty respondents highlighted whether or not they noticed an improvement or not on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) after the students used *Mathletics*™. Direct quotes to support this theme include:

- Last year would have been our first year for that data and we definitely noticed an improvement pretty much across the board… (Teacher Participant T12).

- I believe that it did help the students. It provided them with a little bit of support as far as obviously an extended practice from the concepts that we were teaching in the classroom and that's how I normally use it (Teacher Participant T4).
- A little bit below where we would like them to perform, but I wouldn't put that on *Mathletics*™. There are other reasons for that (Teacher Participant T3).

Theme Four: Extended Practice, Repetition, and Reinforcement

The following theme describes each major theme and subtheme and provides major quotations from faculty participants that illustrate and support the theme and subthemes. Table 11 depicts the master heading and the two subheadings for emergent theme four:

Table 11

Emergent Theme Four

Master Heading	Subheadings
Extended Practice, Repetition, and Reinforcement	Practicing basic math skills.
	Students needing extra support.

Practicing basic math skills.

Faculty respondents highlighted the benefits of utilizing *Mathletics*™ in the classroom for students to get extended practice, repetition, and reinforcement. "… It is just straight practice and … you can never lose by practicing" (Teacher 6). A faculty respondent asserted that extended practice, specifically basic math functions and mathematical problems, through online platforms such a *Mathletics*™ helped improve student learning.

"…the fact they are excited about learning those basic facts, getting them, memorizing them, and doing them quickly, which is what the live, *Mathletics*™ portion really focuses on, has really made a huge difference in that they can do the lessons and are more successful in the lessons. It has definitely made huge improvements with that and I just believe that basic math fact knowledge; if you don't have that, you can't do any of the higher math" (Teacher Participant T12).

When asked to explain in detail why *Mathletics*™ did or did not improve student learning and teaching methods in the classroom nine of twelve or 75% of those interviewed emphasized that *Mathletics*™ had a positive impact on student learning in the classroom. The reasons why the faculty respondents highlighted that *Mathletics*™ improved student learning varied. Faculty respondents reflected that *Mathletics*™ benefited student learning because students could use it as extra practice, reinforcement, and repetition to learning math. The faculty responded highlighted:

- If I assign them certain number of lessons and they finish, they can go onto the live math which they love, and so it's just a really convenient tool that isn't just a game; where they're actually learning and I can challenge them or I can use it for reinforcement and I don't have to have it ready; it's already ready (Teacher Respondent T1).
- I think it improves it because they like it, they enjoy it… I can choose the concepts that the students are working on in the classroom with our textbook and the ones that I am trying to hit for the standards and I can pick out the assignments for that they can practice in the classroom and at home…And parents like it because it's a safe way, safe place for them to go on and learn math, practice math… Also, I do put out like for homework, in terms of homework, since we are doing multiplication, I tell the kids "Go on 10 minutes of anything," and they can choose *Mathletics*™ if they like to practice their math facts with those songs. So that's helpful (Teacher Respondent T2).

- It is a reinforcement, because what I do every week is I assign the things on *Mathletics*™ that go along with what we are studying in the classroom for the week and so, it just gives them… more of what they are just going over it more… I think it is a very positive thing (Teacher Respondent T6).
- … I think it's a good reinforce and good enrichment in practice (Teacher Respondent T7).
- … The constant practice of skill… that they see it in different ways and do it in different ways... (Teacher Respondent T8).
- … any way that you can practice math more has to be a positive thing or it should be (Teacher Respondent T9).
- By repeating it; it just repeats, by practice and repetition (Teacher Respondent T10).
- I think it improves student learning because they are able to work on it during centers or during extra time to make it better for them to learn the specifics… (Teacher Respondent T11).
- It does improve, because once again, it is a positive tool for the students to be able to work with and to give them that extra practice and to be able to enhance those skills that they may struggle a little bit. It is positive because it gives the students an empowerment… (Teacher Respondent T4).

The faculty concurred that *Mathletics*™ is a great supplemental tool that can be added to already existing instruction to help students become more efficient in math. "Once you, as a teacher, have modeled, have worked with the student, they have worked independently, this is an extended practice for them" (Teacher 4). Although many faculty respondents noted the benefits of having *Mathletics*™ as a tool to add to math curriculum, a faculty respondent cautioned that

Mathletics™ should not replace math curriculum. "It's a great supplemental tool, but I would not use it as my main source or resource" (Teacher 3).

Faculty respondents remarked that *Mathletics*™ reinforces the necessary skills that are already being taught in the classroom. Teacher respondents disclosed:

- It is a reinforcement, because what I do every week is I assign the things on *Mathletics*™ that go along with what we are studying in the classroom for the week … it just gives them… more of what they are just going over it more… I think it is a very positive thing (Teacher Participant T6).
- You need everything. It has to be coupled. Most definitely you have to have the teacher teaching, modeling … this is just … an extended practice to be able to enhance those skills … I see it is only a tool to work with the students, but only as an added and extra stuff to provide the support that the students need (Teacher Participant T4).

A faculty respondent reflected that when using Mathletics™ in the classroom that it was not only a tool to reinforce what was being taught in the classroom, it was also an extension to existing student knowledge. Mathletics™ provided a variety of ways to learn how to answer math questions. A faculty respondent elaborated:

> Well, I could say that like I can remember when we were doing ratios, that it was not only repeating what we did, but it extended what we did. It was a little harder than what was in our textbook, so, it meant that I really had to re-teach it, so that they can answer *Mathletics*™ (Teacher Participant T10).

A faculty respondent also emphasized that *Mathletics*™ enables them to assign math topics for students to practice that align with core math curriculum to individual student needs. Most of the faculty respondents expressed that practice and repetition when computing math problems is great reinforcement. A faculty respondent noted that "The students that take it seriously, they move on more quickly, they can get reinforcement for topics that they struggle with" (Teacher Participant T1).

Teacher Participant one also emphasized how *Mathletics*™ improved student learning by providing an example:

> I did have one student last year that was accelerated, so his mother wanted me to do stuff for him. She was happy with that, that being something that he could accelerate in and challenge himself, and I was able to monitor him on it and give him things that to challenge him, and then when he was having trouble, he would come and ask me and it was good because I found things that he didn't know that basic things came to him very quickly but then the more challenging math it was more of a struggle so that was kind of good I think for him to see too that math wouldn't always be easy for him (Teacher Participant T1).

Students needing extra support.

Faculty respondents also emphasized that *Mathletics*™ benefits students that need extra help. *Mathletics*™ can assist students struggling with mathematics by providing an avenue to practice math. Six of 12 or 50% of faculty respondents reflected that a digital tool helps students that need extra support. Teachers can take action by responding to student needs. Direct quotes from faculty respondents to support this theme include:

- It's reinforcement for those who have the extra need at the bottom of your scale. So they get extra help or there is another avenue for them to get help that doesn't require me standing over their shoulder…you are able to cater more specifically to student needs (Teacher 3).

- … the ones that are struggling but are interested, you know, they like to do it too (Teacher Participant T1).
- … with some kids it is frustration, because it is a little bit challenging (Teacher Participant T6).
- The kids may have already done the one you are assigning, but you can assign to any student who received less than an 85%. So, may be they have already done it, but they got a 60%. And I am even doing that, once I have assigned it, I will go back and reassign it to anyone who didn't do well (Teacher Participant T5).
- Sometimes some of the students had struggled a little bit I see. I try to keep it as positive as possible, but if they see some scores like this, they get a little discouraged, but then again, you know, I sit with them one-on-one and then we go over it … it has to be coupled with all the other areas, you know, of support, working with the teacher and especially for those students who need the extra support (Teacher Participant T4).
- I definitely have one student that comes to mind, who kind of gets a mental block when he does math; when it's in a workbook or a worksheet or that kind of thing. When he goes on the computer, his mindset changes and he is usually much more successful and he is a student who struggles in math, so when I see him react that way, it's a great thing (Teacher Participant T9).

A faculty respondent also cautioned that when students do not understand a concept in math, students should not rely on a digital tool to provide an explanation to answer the problem correctly "If a kid really doesn't understand at all, if they are missing a concept completely then they need to come to me and not the computer" (Teacher Participant T8). The faculty respondent elaborated:

- It's not intuitive enough to know what the real question is; what the child is really struggling with (Teacher Participant T8).

Theme Five: Professional Development

The following section describes each major theme and subheadings and provides major quotations from faculty participants that illustrate and support the theme and subthemes. Table 12 depicts the master heading and subheadings for emergent theme five:

Table 12

Emergent Theme Five

Major Theme	Subheadings
Professional Development	Time management.
	Hands on practice.

The majority of faculty also noted the need for additional training on how to use *Mathletics*™ in order to have more of an impact on student learning and teaching methods in the math classroom. Seven of twelve faculty respondents or 58% reflected that additional training would help them become more familiar with the digital tool in order to improve student learning and teaching methods in the math classroom. They expressed the necessity of having more formal training on the functionality of *Mathletics*™. Direct quotes from teacher respondents supporting these themes included the following:

- I would like to have a more thorough training on the potential of the program, but I'd also like to learn it if I could flip it, if they could try the problems first and then I teach it (Teacher T8).

- If you can seek out professional development, so that you knew the program better. You know, it is like you know the program better before you assign it to the kids… With more professional development, it would be easier to use it in the classroom. Like, how to clear up grades and we had a little bit how to change people from different grade levels. I sort of figured it out … but it was time consuming… (Teacher T10).
- They kind of have to figure out what works best for them, but that it is useful and the kids like it and I would recommend it. And maybe you know, train them, show them some of the tricks, because when you first look at it, and like for example, going to the Results you would never guess that that's where you would assign the assignments, you know, something like that, so maybe show them the tricks to it (Teacher Participant T2).
- When we first started last year, it was definitely a challenge learning all the in's and out's and they made a lot of tweaks to the program (Teacher Participant T12).
- Make it easier for the teacher to understand it (Teacher Participant T11).

Time Management.

Faculty expressed the impact on student learning and teaching methods could be greater if they had the necessary training that enabled them to have the knowledge about the aspects of the program. A faculty member noted that proper training could save teachers significant time in trying to learn the functionalities rather than teachers exploring it on their own. A faculty member further elaborated with an example:

> Like, how to clear up grades and we had a little bit how to change people from different grade levels. I sort of figured it out … but it was time consuming to figure it out, so if you give somebody else 4th grade standards even though they are in 6th grade class because

they needed remediation. You know, and it was just a little confusing without spending a lot of time on it (Teacher Participant T10).

Hands on practice.

Faculty members noted hands on practice in addition to formal training was beneficial in learning the functionality of the program. Exploring the digital tool thoroughly and how the tool is organized can help a teacher become more prepared when assigning *Mathletics*™ in the classroom. Faculty respondents emphasized:

- The biggest thing with any part of them with that is I think is that you have to sit down and just explore yourself and go through all the different tabs and what they offer because there is always more to find and until you actually, we sit through teleconferences or we get emails about updates but until you are actually in there and signed on and you are clicking and using it, it is really hard to just take it from a teleconference if you are not looking at it at that time (Teacher Participant T9).
- I think with the training, when you haven't play with it yet, it's hard to even really know what they're talking about. I'm a person that has to sit down and just mess with it before I can (Teacher Participant T7).

Theme Six: Alignment of Core Curriculum and Expected Math Standards

Theme six provides major quotations from faculty participants that illustrate and support the theme. Subheadings did not emerge for this major theme. Table 13 depicts the master heading and subheadings for emergent theme six.

Table 13

Emergent Theme Six

Master Heading	Subheadings
Alignment of Core Curriculum and Expected Math Standards	

Faculty respondents also expressed that *Mathletics*™ aligns with math curriculum and expected math standards. Nine of twelve or 75% of faculty respondents expressed that either they used *Mathletics*™ to support what they were teaching in the math classroom or that *Mathletics*™ aligned specifically to what was being taught in the math classroom. The faculty acknowledged that when teaching core curriculum required by school and state standards, teachers could easily match *Mathletics*™ questions to what is already being taught in the classroom. Many of the faculty respondents discussed how *Mathletics*™ supported current math standards in their respective classrooms, how the functionality of the digital tool helps the students learn math skills, and how the *Mathletics*™ reporting supports those standards. The following comments were reported from the faculty interview data:

- I think it makes you more aware of your standards … and it helps… when you are seeing a report and you are seeing like a lot of the class is scoring low on a particular standard you know that is something that you really need to go back and work on. So, it is a good reference (Teacher Respondent T6).

- I think it hits all the curriculum really well, and it really does cover all the standards that we are expected to do. I love that it has the option to choose things that are above or below the student's current level, so I can pull from second grade level or I can pull from fourth grade level (Teacher Respondent T12).
- We do common core and *Mathletics*™ focuses on that and I specifically assign lessons based on what we are currently learning in our units (Teacher Respondent T9).
- … I would say when I assign them a certain skill or set of problems that I have taught and they're doing it incorrectly that help window comes up and reinforces what they're doing wrong … (Teacher Respondent T8).
- I would say it correlates to our textbook, to the standards, to Common Core in a positive way. It's something that I can use that gives kids the incentive to learn and want to learn math, helps them learn in a fun way…I wouldn't say it has negative just because a lot of the skills relate to the standards, and I am assuming that the standards align with the Iowa's… I can choose the concepts that the students are working on in the classroom with our textbook and the ones that I am trying to hit for the standards and I can pick out the assignments for that they can practice in the classroom and at home…The concepts correlate to what we are teaching in school, so I would say It's positive (Teacher Participant T2).
- …it's helped me really focused on trying to teach the standards and get away from the whole thing of going through a textbook… (Teacher Participant T1).

- …I think another thing that is good about it is when I can assign those specific things that we are doing currently in class… (Teacher Participant T5).
- Yes, to enhance those skill that we teach, you know, as far as following our benchmarks and our standards…I believe it stays positive within the students and they look forward to work with *Mathletics*™ and yet they don't know, that you are actually embedding those standards in that extra practice (Teacher Participant T4).

A faculty respondent cautioned that although *Mathletics*™ was utilized in the classroom to support learning 5th grade standards, *Mathletics*™ is not aligned specifically to the standardized tests used for 5th grade math. "We used it based on the 5th grade standards. That's the way I used it, but the Iowa's aren't aligned to that specifically…" (Teacher Participant T3).

Theme Seven: Principles and Methods for Math Instruction

The following section describes each major theme and subheadings and provides major quotations from faculty participants that illustrate and support the theme and subthemes. Table 14 depicts the master heading and subheadings for emergent theme seven.

Table 14

Emergent Theme Seven

Major Theme	Subheadings
Principles and Methods for Math Instruction	Differentiated learning avenues.
	Individualized learning opportunities.
	Instant feedback.

Differentiated learning avenues.

Many faculty respondents revealed several key principles and methods for instruction used with *Mathletics*™ that help them to achieve desired student learning and teaching methods results in the math classroom. Faculty respondents highlighted that *Mathletics*™ provides differentiated learning avenues, individualized learning opportunities, and instant feedback to the math classroom. A faculty respondent noted that *Mathletics*™ enables students to experience a change of pace when learning math topics. "It definitely gives the kids a change of pace, and I think with this generation, they don't want to just be sitting there doing their worksheet all the time. It helps them just to get up and get some movement and have a different perspective on how they are learning" (Teacher Participant T9).

Faculty respondents emphasized that *Mathletics*™ provides differentiated learning avenues that enable students to have a varied approach to learning math. Six of 12 or 50% of faculty respondents emphasized that *Mathletics*™ provides other avenues for learning the same math problem. Direct quotes from faculty respondents to support this theme include:

- Having another resource to use to teach from (Teacher Participant T11).
- …teaching the same concept in different word problems, in, you know, the way that the problem is laid out so that they see it multiple ways… It also provides them with, I don't want to say a mentor, but another person teaching them whether it's virtual or not they are learning from someone else (Teacher Participant T8).
- …when you have a kid that doesn't get it one way to be able to teach him the other way… (Teacher Participant T7).
- It helps them just to get up and get some movement and have a different perspective on how they are learning…you can offer them an additional way of looking at how a

problem is solved or a method for solving, that's got to be a positive thing. They certainly will decide this is the way I like best and they kind of have it on that, but I think *Mathletics*™ just gives them one more tool (Teacher Participant T9).

- …gives a variety and differentiation to just using the textbook and then showing the video…and then it also helps to reiterate what I am teaching and it shows them possibly a different way to do a problem (Teacher Participant T2).
- Well, just like I said that it allows me a wider variety of problems to give them…it gives them more exposure to a wider variety of problems than I could – I mean I could spend my time coming up with tons of problems for them to practice on, but it certainly is convenient for that and it has a help button if they're wanting to see how to do the problems. Some of the problems have videos and so if I'm working with someone else, so they just want to try it on their own they can (Teacher Participant T1).
- …differentiation would be the biggest benefit. You are able to cater more specifically to student needs. The faster kids can move ahead without waiting for you, and then the kids that need a little bit of extra reinforcement can get it also (Teacher Participant T3).

Individualized learning opportunities.

Many faculty respondents highlighted that *Mathletics*™ enables students to learn at their own pace. Eight of 12 or 67% of faculty respondents reported that *Mathletics*™ provides ways for students to be able to individualize their own learning. Direct quotes from faculty respondents to support this theme include:

- …It definitely can be a positive thing if the kids are independent, and I taught third grade last year and now I teach sixth, but even in third grade, once they learned how to use it, it was very independent…so the idea is to let each student progress at their own pace and it's working pretty well… I believe it helps them learn through discovery to some extent, and, you know, if they're having a difficulty with a particular problem, you know, persevere hopefully through it and obviously on the Iowa that's what we want them to do because if they come across a problem they don't know how to do, how can I figure out the best answer (Teacher Participant T1).

- It's beneficial to those who really need the extra help or to those who want to move quicker at their own pace (Teacher Participant T3).
- …I can also adjust it to make it harder or easier based on the student so it's differentiated instruction as well… (Teacher participant T2).
- I also like that some of my students who have mastered grade level math can go on and challenge themselves and challenge other people and kind of teach themselves to do more (Teacher Participant T8).
- The only problem I've really run into is kids going and doing things that they haven't been taught yet (Teacher Participant T7).
- Some of the students, for example, I know struggle a little bit with some of theirs; and I go back and I, you know, reassign those assignments and when they see that they need to redo it, then they take their time and then if they have any question, they raise their hand and I work with them one-on-one. Sometimes I sit down with them and I can actually address some of those areas where they need and so, I believe it improves them and obviously you start seeing better scores…Once you, as a teacher…(Teacher Participant T4).
- I alternate between assigning specific tasks to students and allowing them to freely choose. This allows them to seek out topics that are interesting or challenging to them

and tack them as they feel ready. Each student's record on *Mathletics*™ is unique (Teacher Participant 12).

Faculty Participants T1 and T4 further elaborated on how *Mathletics*™ was used in the math classroom to provide students with individualized learning opportunities while improving student learning.

- I can place them in different group, so if they need remediation or if they need acceleration, I can separate it out that way and it also allows me to see where they're struggling or if they're not struggling and they can move on more quickly than the rest of the group, so it's definitely been an -- a tool that's help me analyze each student individually, a lot more clearly (Teacher Participant T1).
- Once you, as a teacher, have modeled, have worked with the student, they have worked independently, this is an extended practice for them (Teacher Participant T4).

Instant feedback.

Faculty respondents also elaborated on the ways that *Mathletics*™ provide instant feedback. Seven of 12 or 58% of faculty respondents emphasized that students receive instant feedback through a help window or explanations of how to answer math questions. A retry option is also available for students that do not answer a question correctly the first time. Direct quotes from faculty respondents to support this theme include:

- … I wish that when they turn in their homework, I could check it right then and before the math class, I know where everyone is; that is unrealistic. So, with *Mathletics*™, I could look and see, "oh, we are not doing so well"… when I was a kid; you would go home and you would do a worksheet and you think you did them alright, you did 20 problems, you get to the school the next day and you have done 19 out of 20 correct, where with *Mathletics*™, you do one incorrect and you know right then (Teacher Participant T5).

- They love math, they do like it and I think the first few times a help window comes up they're okay but if it's – if it's ongoing that they just don't get it, they're not willing to stick with it and find out why… instant feedback is good only if they take the time to really see what they did wrong, so it's just too easy for them to say oh yeah, yeah and then click. That was – they just move through it (Teacher Participant T8).
- I would just say it is reinforcing. Like, if they get something wrong, they can watch like an explanation of the correct way to do it. So, it is an instant, like, teaching method (Teacher Participant T6).
- … the retry button will show up and sometimes it won't, so I would like them to always have the option of retrying, because a lot of times the kids will come up to me and say can you assign me that one again because I know what I did wrong and I want to try it again…I encourage them to look at the Help first and to watch the video if it's available and then ask me if they still understand, so it's positive in that way. It does help them – because I really, you know, as a teacher want them to learn to discover on their own, so by using those Help they're trying to help themselves before they ask someone else for help, so It's a positive in that way (Teacher Participant T1).
- I get that great feedback from it as a teacher, but students also can see right away how they performed. They have the option to walk through extra explanations of skills and to retry whenever they feel ready (Teacher Participant T12).
- …you can see what you did wrong immediately, I think that is positive reinforcement (Teacher Participant T7).

- It shows them how to work it out step by step. So it gives them an example which is helpful. Lot of the other websites don't do that (Teacher Participant T2).

Analysis and Synthesis of Findings

Central Research Question

The purpose of the central research question was to draw conclusions and find a mutual understanding from a combination of the assessment scores and faculty perceptions of the utilization of interactive media use in the classroom. First, student assessment scores demonstrated that *computation* scores aligned with teacher perceptions of positive improvements to assessment scores when an interactive media tool is utilized in the classroom. Second, faculty perceptions about interactive media emphasized a positive impact on *computation* scores on student learning and teaching methods. Overall, teacher perceptions of interactive media use in the classroom provided opportunities for students to improve their math skills and encouraged teachers to utilize technology in the classroom in order to improve teaching methods. Assessment data shows no impact for the *math* section and a small impact on the *computation* section. Results from standardized test scores for the *computation* section indicated a small effect size, indicating a meaningful impact on student learning. Faculty perceptions supported the idea that interactive media had a positive impact on student outcomes and teaching methods in the classroom: engaging, collaboration, student excitement, challenging, extra practice, competition, individualized, supplements existing instruction, aligns with standards and math curriculum, instant feedback, and differentiated learning avenues. However, faculty interviews also revealed challenges when *Mathletics*™ was used in the classroom: (1) Internet and technology issues, (2) availability and access to computer device issues, (3) lack of reporting data for faculty to analyze student achievement, (4) the need for faculty developmental programs and additional training. These interviews provided a deep understanding about the positive aspects of *Mathletics*™ use and challenges faculty face when implementing digital tools in the math classroom.

Quantitative and Qualitative Questions

Analysis and synthesis of assessment and interview data provided knowledge and insights into whether or not interactive media incorporated into the classroom impacts student learning and teaching methods. The assessment data and interview data collected in this study presented both positive results and challenges. Results from assessment data indicated that a supplemental digital math tool did not have a statistically significant difference on student learning and teaching methods on the *math* section; however, results indicated there was a statistically significant difference on the *computation* sections. In addition to the assessment results, faculty responses to open-ended interview questions illustrated that there was a positive impact on student learning and teaching methods when *Mathletics*™ was utilized in the classroom. Faculty respondents voiced that interactive media in the classroom led to positive results in student learning, an increase in student motivation, helped students get extended practice with math functions, aligned with already existing math standards, and provided students with additional ways to learn math. However, responses to open-ended questions also emphasized that a majority of faculty respondents expressed the need for additional reporting tools and teacher training in order to become more effective. Faculty respondents also voiced some technology issues and a lack of availability of computers and tablets in order to be most effective when using interactive media in the classroom. Table 15 and 16 are provided below to provide a quantification of the assessment scores and emergent themes. Table 15 depicts the results of a statistically significant difference on *computation* scores between two groups of 6th grade math students. Table 16 illustrates quantified strength of emergent themes with respondent quotes. The strength of emergent themes was determined by the ratio and percentage of the respondent quotes for each theme, 12 of 12 or 100% being the strongest and 7 of 12 or 58% being the weakest.

Table 15

Mean Differences between Mathletics™ vs. No Mathletics™ Computation Section

Mathletics vs. No Mathletics	*N*	*M*	*SD*	*SEM*	*t*	*df*	*Sig. (2-tailed)*
No Mathletics	112	222.14	22.09	2.09	-2.606	236.14	0.010
Mathletics	127	230.36	26.64	2.36			

Table 16

Quantified Strength of Emergent Themes with Participant Quotes

Emergent Themes	Ratio/Percentage of Respondents	Responding Quote
Interactive Media Usage in Math Instruction	12 of 12 or 100%	"I think some students… they open their mind more when it is on the computer because they are so computer literate and surrounded by technology in this generation" (Teacher Participant T9).
		"We have some kids that have a hard time getting on … when they go to the sign in, they might leave out a number or they might leave out the "dash" in their password …" (Teacher Participant T6).
Utilization of Data to Inform Instruction	12 of 12 or 100%	"I would like it if they had a wider variety of reports" (Teacher Participant T1).
Extended Practice,	12 of 12 or 100%	"It does improve, because

Repetition, and Reinforcement		once again, it is a positive tool for the students to be able to work with and to give them that extra practice and to be able to enhance those skills that they may struggle a little bit. It is positive because it gives the students an empowerment…" (Teacher Respondent T4).
Principles and Methods for Math Instruction	11 of 12 or 92%	"It definitely gives the kids a change of pace, and I think with this generation, they don't want to just be sitting there doing their worksheet all the time. It helps them just to get up and get some movement and have a different perspective on how they are learning" (Teacher Participant T9).
Student Motivation and Engagement in Learning	10 of 12 or 83%	"It's another way to engage the students… the electronics is preferred by them and it's, you know it's just another tool that I can use to keep them engaged" (Teacher Participant T8).
Alignment of Core Curriculum and Expected Math Standards	9 of 12 or 75%	"I think it hits all the curriculum really well, and it really does cover all the standards that we are expected to do. I love that it has the option to choose things that are above or below the student's current level, so I can pull from second grade level or I can pull from fourth grade level" (Teacher Respondent T12).

Professional Development	7 of 12 or 58%	"If you can seek out professional development, so that you knew the program better. You know, it is like you know the program better before you assign it to the kids… With more professional development, it would be easier to use it in the classroom. Like, how to clear up grades and we had a little bit how to change people from different grade levels. I sort of figured it out … but it was time consuming…" (Teacher T10).

Although data suggested that *Mathletics*™ impacted student learning and teaching methods, it was evident there were issues surrounding the use of *Mathletics*™ in the classroom. The researcher compared the student scores and emergent themes by utilizing "side-by-side comparison for merged data analysis" (Creswell & Plano Clark, 2011 p. 223). An evidenced-based model will be discussed in the next section to aid faculty to include interactive media in the classroom was needed.

Proposed Solution

The aim of this study was to determine whether or not *Mathletics*™ improved student learning and teaching methods in the 6th grade math classroom and created evidence-based solutions for school leaders from the research findings. Faculty participants emphasized challenges when utilizing interactive media in the math classroom: (1) Internet and technology issues, (2) availability of computers and tablets, (3) the need for reporting tools and data to analyze student performance, and (4) the need for faculty professional development programs and additional training. An evidence-based solution was devised to address faculty concerns about the use of digital tools in the classroom. These data suggested that effectively incorporating interactive media in the classroom could positively impact student learning and teaching methods. Based on the data analysis, an interactive media plan was designed to effectively improve the best practices of incorporating interactive media in the math classroom. Faculty respondents noted positive results surrounding interactive media usage in math instruction; student engagement in learning; extended practice, repetition, and reinforcement; meeting expected math skills and standards; and principles and methods for math instruction. Faculty respondent also highlighted concerns of Internet and technology issues, availability of computers and tablets, availability of reporting tools and data, the need for teacher professional development were evaluated. Figure 3 is a visual model illustrating how the proposed solutions lead to effective technology use in the math classroom.

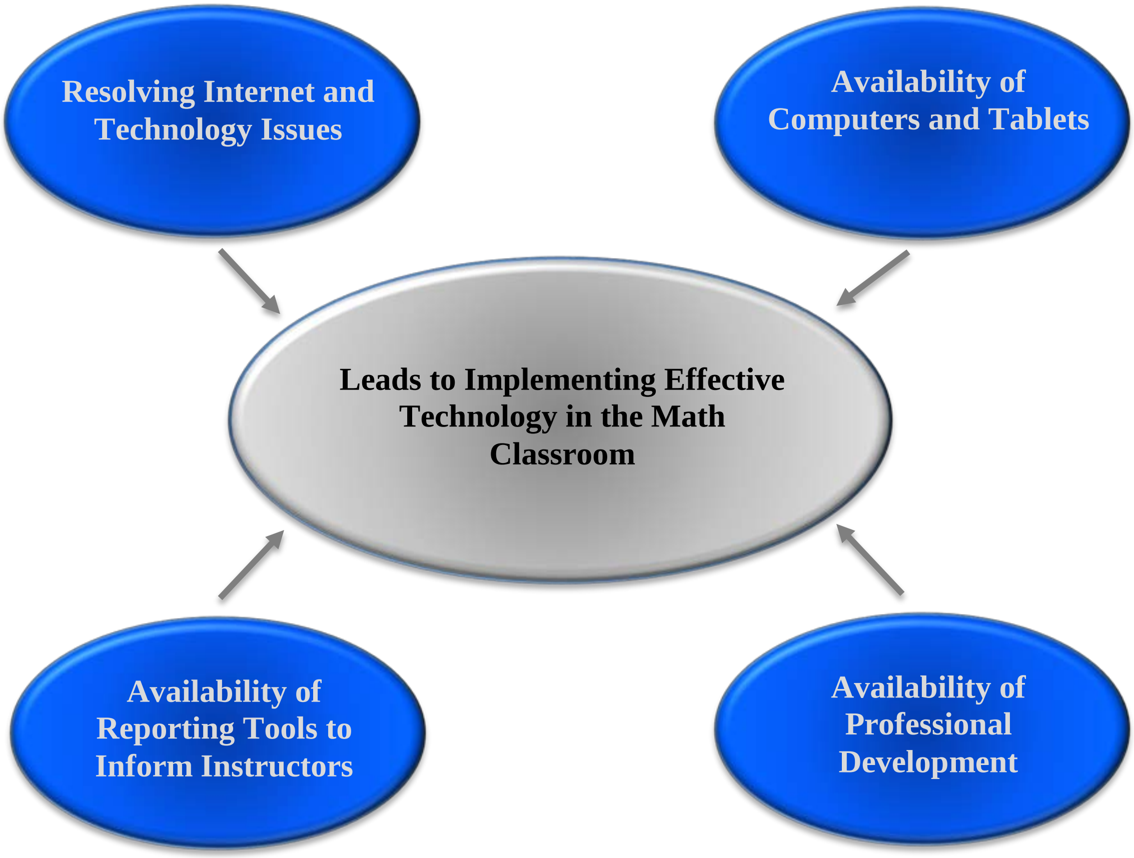


Figure. *3*. Visual Model Illustrating the Proposed Solutions.

The following paragraphs describe a framework for school administration to follow when incorporating interactive media in the classroom.

Addressing Issues of Interactive Media in Math Instruction

Faculty noted significant benefits to adding interactive media to the classroom. Students tend to enjoy working math problems through a variety of online tools. The addition of a supplemental digital tool to in-class instruction provided a way for students to practice math problems that made it more exciting. The use of online certificates, student collaboration, sounds, videos, and games offered students a fun and motivating method of learning. Incorporating *Mathletics*™ to classroom instruction could encourage students to practice math often. Study findings indicate *Mathletics*™ supplies an opportunity for students to learn math in a fun way, fosters a way for students to interact, collaborate and learn from one another, and provides a way to learn remotely.

Alternatively, many faculty respondents noted some log-on and internet issues when using *Mathletics*™. Students struggle with logging on to the initial *Mathletics*™ online platform. To provide ways to assure students are able to log into the online platform faculty should be aware of the common issues affecting student log-on attempts. To assure students are able to log on to the online platform, log on passwords should be standardized and easy for students to remember. A recommended student username could include the students' first initial and last name. The passwords could include a unique word. For example all student passwords could include the students' favorite food. An example of a student username and password with instruction to help students remember their username and passwords could also be written on the classroom's white board.

Internet issues such as the digital tool not connecting to the Internet are common in this study. A consistent process should be developed and implemented for each school to improve Internet issues. A log should be recorded for when and why there was an Internet issue for every occurrence. This will help faculty and administration identify the types of Internet issues and how often it is occurring. A technologist specialist could be assigned to each school that would assist teachers in resolving log on and connection issues (Ozel et al., 2008). A report provided by the U.S. Department of Education (n.d.) highlighted that schools integrating technology into the math classroom should provide technical help as soon as it is needed. An Internet trouble-shooting guide should be developed for faculty and students to follow when the most common Internet issues occur. Trouble-shooting steps could include: (1) rebooting the device, (2) Investigate whether the issue includes one or multiple devices, (3) if the issue includes one device reconnect the wireless device or notify administration so that the issue can be resolved, and (4) if the issue includes multiple devices contact the internet provider.

Availability of Computers and Tablets

During faculty interviews, the concern of limited computer devices was apparent. Faculty voiced concern regarding the lack of computer devices to students. In this case, it is essential for faculty to plan for the use of computer devices in the classroom. Roblyer (2016) suggests that a cost-effective way to optimize availability of technology in schools is to use spare parts from unused computers, utilize donated equipment, and ensure faculty and students follow safety and computer maintenance procedures when needed. Through faculty planning, students can also rotate computer use with another instructional activity. The research findings indicate that while some students practice using interactive media during class time, other students can work on paper and pencil activities. Then, the students that were using interactive media can work on paper and pencil activities while the other set of students use the computer devices.

Another solution is to pair the students in groups. Two students to one computer can keep the students engaged with interactive media, foster teamwork, and offer the opportunity for students to collaborate and help each other during the time they are utilizing interactive media.

Utilization of Data to Inform Instruction

A significant concern from faculty respondents was the need to obtain useful student performance information in order to make suggestions that will help guide student math improvement. Often times, “we make teachers the objects of research rather the people who do research” (Tucker & Darling-Hammond, p. 191). To improve the faculty knowledge of student progress, we must encourage faculty to conduct research by analyzing and synthesizing student assessment data. Exposure to student assessment data can help faculty discover whether or not students need additional help and help guide them through the learning process. Obtaining student data enables faculty to become teacher leaders in order to make informed decisions about individual student needs and classroom instruction. Specifically, faculty utilizing student assessment data are able to inspect, discover, and measure individual student achievement, progress, and trends. Tucker & Darling-Hammond (2014) suggests that to have the highest level of student achievement, teachers should be prepared to identify student problems and develop effective solutions. Providing the opportunity for faculty to analyze student data could enable an environment where faculty can become part of the leadership process in suggesting conclusions and decision-making about Catholic school math achievement toward expected learning outcomes. Faculty can also provide effective feedback to both the student and parent.

Professional Development

Faculty respondents emphasized lack of professional training on how *Mathletics*™ could best be used in the classroom. A critical step to best improve the use of interactive media tools in the classroom, faculty should learn or develop the knowledge needed to best incorporate interactive media within the math classroom. Roblyer (2016) emphasized the importance of providing ongoing teacher professional development to effectively integrate interactive media in the classroom when technology advancements occur. Facilitating faculty training and development workshops on how to best incorporate interactive media in the classroom could improve student learning and teaching methods in the math classroom. Workshops should include hands-on practice with the *Mathletics*™ online platform to offer the most realistic environment. Faculty hands-on workshops should be guided and taught by the most knowledgeable resource or expert within the school. Each school could designate an interactive media lead to facilitate workshops that would offer the best ways to utilize interactive media in the classroom.

Increased knowledge about the use of interactive media in the classroom and hands-on practice would uncover the most effective teaching methods for improved student learning. Faculty could then share best practices during the interactive media workshops. Sharing best practices and incorporating these practices would consistently align teaching methods with the use of interactive media in math classroom environments.

Support for the Solution from Data Collected

According to the Programme for International Student Assessment (PISA) Results from PISA (2012), math students in the United States continue to struggle with "performing mathematics tasks with higher cognitive demands, such as taking real-world situations, translating them into mathematical terms, and interpreting mathematical aspects in real-world problems" (p.1). Literature suggested that technology improves 21st century teaching and learning (Chen & Sun, 2012; Gunbas, 2015; Ponce, Mayer, & Lopez, 2013). Thus, school leaders have implemented supplemental digital math tools in private, Catholic classrooms to improve 21st century teaching and learning. However, Ernst & Clark (2012) emphasized that "more time should be spent selecting the appropriate software with teacher feedback" (p. 44).

Student assessment data revealed that supplemental digital math tools such as *Mathletics* ™ could improve student learning and teaching methods in the math classroom. Data indicated that student assessment scores increased for the *computation* section of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) when students used *Mathletics*™ versus students that did not use *Mathletics*™. However, data did not indicate a statistically significant difference in the *math* score of the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) between students that used *Mathletics*™ versus students that did not use *Mathletics*™.

Faculty interviews emphasized that *Mathletics*™ improved student learning and teaching methods by motivating and engaging students to learn, providing avenues for student to practice, repeat, and reinforce basic math skills, assisted students that needed extra math support, provided differentiated learning avenues, catered to individual learning, and produced quick and instant feedback. Faculty interviews also indicated concerns regarding Internet and technology issues, availability of computers and tablets, availability of reporting tools and data, the need for teacher professional development. Faculty comments also highlighted incorporating *Mathletics*™ in math instruction encourages student learning, increases student learning, and provides effective methods for classroom curricula. The results of these data illustrate the rationale for the aim of this study.

Existing Support Structure and Resources

Support and resources exist that could aid in the implementation of a plan to improve the use of *Mathletics*™ in private, Catholic schools. The Diocesan schools provide tools and resources for administrators and faculty to utilize in order to improve student achievement. An example of existing support structures that encourage schools to effectively incorporate technology are at the Diocese of Orlando. The Diocese use technology toolbox and technology plans to enhance the students' technology experience. These resources are provided for administrators, teachers, and students at all grade level. The tools encourage the ongoing effort to ensure the latest technology is a focus within the classroom. Other Diocesan support structures and resources include the Florida Digital Educators, Future of Education Technology

Conference, and the International Society for Technology in Education (Orlando Diocese Technology Resources, 2016).

Other support structures and resources that can assist in increasing the knowledge of technology literacy, specifically surrounding the use of supplemental digital tools in the math classroom, include certification programs at higher-level institutions. For example, there is a certificate program that specializes in educational technology at Rutgers University (Rutgers University (n.d.). There is also an online certificate in K-12 Teaching with Technology (University of Florida, n.d.). For the proposed solutions of this study to be successful, engaging in continuing education and lifelong learning opportunities may improve teaching strategies to support interactive digital media in the Catholic school math classroom. A *Mathletics*™ teaching certification is also available for Faculty interested in learning how *Mathletics*™ can be effectively integrated into math curriculum (*Mathletics*™, n.d.).

Several private, Catholic schools in Florida are currently utilizing *Mathletics*™ within the math classroom. School administration and faculty are enthusiastic and motivated about incorporating digital technology in the classroom and welcome discussion on how to improve student learning. Through continued administration and faculty participation and engagement, digital tools may help improve student learning and teaching methods in the classroom environment.

Continued administrative support, professional training opportunities, generating enthusiasm, and motivation to include digital tools in the math classroom may be effective drivers in improving student learning and teaching methods. Administration and faculty professional development and the use of data to research student achievement trends are essential in improving the use of digital technology in the math classroom. Educational leadership and faculty could continuously compare assessment data each year to track the impact and determine whether improvements exist. Educational leaders may analyze assessment data by gathering assessment data and comparing the assessment data to the previous year. The continual review of assessment data may show an increase or decrease in student math achievement. Additional support resources that support interactive media in Catholic schools utilize digital tools can be utilized to continue the improvement of student learning and teaching methods.

Policies Influencing the Proposed Solution

Current Policies

The International Society for Technology in Education (ISTE) (2016) devised a set of standards to aid schools in improving the use of technology in the classroom. The ISTE (2016) standards were developed to provide a framework for schools to progress at the same rate with ongoing technology changes and help prepare students to enter the workforce (Retrieved at http://www.iste.org/standards/standards). The ISTE (2016) frameworks include Student, Administration, and Teacher standards. Catholic schools utilize this structure as a guide to improve student learning and teaching methods. Catholic school policies are influenced by the ISTE (2016) standards to implement and incorporate technology in the classroom. Although these standards are implemented within Catholic schools, school leaders continue to refine curriculum in math instruction to include the latest technology.

Recommended Proposed Policies

Study findings indicate that policies that aid to improve Internet and technology issues, availability of computer devices, data analysis, and professional development programs could be implemented to impact student learning and teaching methods. Specifically, policy structures that include professional technology integration training that would transfer digital technology knowledge to administration and faculty members could result in improvement to student learning and teaching methods in the math classroom. A faculty committee could be devised under the direction of a school principal to include a head teacher from each school within the diocese to prepare training curriculum for faculty.

Training curriculum could use curriculum mapping to develop and implement effective teaching strategies that align with digital learning standards. Training development topics could include how to provide effective student feedback through the use of interactive media, strategies to keep students motivated and engaged through the use of interactive media, and how to analyze and synthesize assessment data to improve student learning and teaching methods. Professional education could include workshops to share best practices of the utilization of digital tools in the classroom. Educational workshops may also promote faculty collaboration to find best practices. Hands-on training could also improve teaching methods for faculty by involving practical and real-life examples. The training curriculum could be reviewed, assessed, and approved for its effectiveness by the Catholic school administration and the teacher technology integration committee. Professional training could result in consistent use of interactive media to improve teaching methods and strategies in Catholic schools.

Developing and implementing policies to improve student and teaching methods require time and financial resources. Administration leaders could follow the three phases of Technology Integration Planning (TIP) model: (1) first assess technology needs in the math classroom according to current technology standards and determine the advantages that interactive media has on the math classroom, consider the most effective digital teaching methods to meet school goals, and design and define the teaching strategies that align with the goals of your school, (2) prepare a plan to provide an effective integration of interactive digital media by integrating the proposed solutions of this study and prepare the math classroom for the integration of interactive media, (3) determine the impact that the integration of interactive media had on student learning and teaching methods and analyze the results of the proposed solutions and make appropriate changes to impact student learning and teaching methods (Roblyer, 2016). Education leaders and faculty could also recognize and utilize additional resources to help obtain the best support, and identify the appropriate level of technology use in every classroom. These considerations can determine the financial resources needed to integrate interactive media in the classroom.

Potential Barriers and Obstacles to Proposed Solution

The results gained from faculty respondent data emphasized challenges with Internet and technology issues, availability and access issues, lack of reporting data to analyze student achievement, and the need for additional training when utilizing interactive media in the classroom. There are effective solutions to overcoming these barriers; however, administrative and teacher leaders must be engaged and motivated in identifying the need for change and implementing effective change to overcome these barriers. Implementing new policy structures to meet educational technology needs in math instruction is not an easy task, and increased knowledge of how to integrate these technologies is needed (Burke, 2011). It is essential to develop future teacher leaders to improve K-12 student learning and teaching methods (Stigler & Hiebert, 1999). Faculty team-building activities can help promote the overall implementation of new interactive media strategies (Burke, 2011).

The ability to identify problems and developing effective framework to resolve technological issues in the classroom is critical. Students experiencing ongoing computer problems may result in a lack of participation and motivation to implement interactive media in the math classroom. Timely resolution of Internet and technology issues is essential to utilizing supplemental digital tools in the classroom. Students should have access to computer devices and educational members should attempt to provide creative ways for availability of computer devise. Teacher leaders should also be equipped with student assessment data and other supporting data in order to make informed decisions about student progress. Lack of access to assessment data leaves teachers without the proper tools to assess the level of knowledge of students. Finally, school administration should implement ongoing professional development for interactive media that includes how to effectively use digital tools in the classroom, how to assess student progress using digital tools, and to engage students in using these tools. Professional development could be hands-on to provide faculty with real world experiences; experiential to enable faculty to practice with interactive media and reflect on how interactive media impacts the classroom; and collaborative to provide faculty with an environment where they can share best practices.

Financial/Budget Issues Related to Proposed Solution

Schools may lack the funding needed to integrate technologies in the classroom (Roblyer, 2016). As technology changes, the need for new hardware and software may increase. Most educational institutions may have limited budget to plan for the rapid technological changes and access to computer devices (Roblyer, 2016). The proposed solutions of this study could aid in building knowledge to improve how educational leaders prepare, plan, assess, and manage interactive media in the math classroom.

Educational leaders could provide avenues for faculty to continuously engage in communication about the pros and cons of interactive media in the classroom. Engaging in communication could be done through an online forum or a face-to-face meeting where common teaching strategies and computer related issues are addressed. Improvements to current teaching strategies and math curricular could then be adjusted or fine-tuned. New systems or frameworks could emerge as a result of sharing ideas through workshops, online discussion forums, faculty roundtables.

Teaching strategies that include sharing of student devices during the time interactive media is used in the classroom could foster student teamwork. Alternative strategies such as BYOD can resolve computer and Internet access issues (Roblyer, 2016). Flipped classroom models may allow students to practice math through supplementary digital tools while at home to open class time for other teaching strategies (Roblyer, 2016).

Legal Issues Related to Proposed Solution

Implementing the proposed solutions may have legal ramifications. Roblyer (2016) suggests that educational leaders and faculty may face legal and ethical issues when attempting to integrate technology in the classroom: (1) Hacking, (2) Safety issues, (3) Academic honesty, and (4) Illegal downloads/software piracy. Hackers may attempt to enter through the school firewall to gain access to student data (Roblyer, 2016). Schools could install firewall to block and prevent hackers from obtaining student personal data (Roblyer, 2016). Roblyer (2016) also suggests that schools could also require students and parents to sign Acceptable Use Policy (AUP) to prevent online predators from contacting students via online platforms. Implementing technology could also provide avenues for student online cheating (Roblyer, 2016). Schools may implement policies that require students to take exams at the school to prevent cheating (Roblyer, 2016). Finally, Roblyer (2016) recommends that teachers practice and model ethical behaviors to prevent students from software piracy.

Change Theory

Rogers' (2003) five stages in the innovation process in an organization can be used as a conceptual model for understanding the implementation of new frameworks for interactive media use in the math classroom. Faculty perceptions about interactive media in the classroom highlighted that students are motivated and engaged when using *Mathletics*™; however, faculty also noted Internets issues, not having enough data to make informed decisions about student learning and teaching strategies and lacking formal training about *Mathletics*™. Educational leadership and faculty are key decision makers in offering solutions to problems that exist in the Catholic school math education. This model can aid educational leadership and faculty in the decision-making process of adopting new strategies and systems to improve student learning and teaching methods. The stages of Rogers (2003) the innovation process in an organization include two phases: (1) initiation including agenda-setting and matching and (2) implementation including redefining/restructuring, clarifying, and routinizing.

Stage One: Agenda-Setting

Rogers (2003) suggests following two steps in the agenda-setting stage. First, educational leadership and faculty should identify and gather the problems that exist when interactive media is used in the classroom. Educational workshops can be established to provide a forum where common problems can be identified, collected, and discussed. Problems identified through this study include Internet related issues, access and availability of computer devices, lack of data to analyze student performance, and the need for professional teacher development. Examples of other common problems that may arise in the future as a result of sharing ideas through faculty workshops, online discussion forums, and faculty roundtables include reconsidering lesson plans to improve student learning, shortages of technology resources, technology trends, cyberbullying, cybercheating, distracting Internet-based media, ethical uses of computer technology, and financial limitations.

Second, educational leaders and faculty should explore the school's resources to find solutions for the common problems that were identified. The technology committee of faculty should plan for how the solutions to the problems will be developed, implemented, and assessed. Planning for these solutions can be discussed in a faculty workshop where team members collaborate to find several solutions to support how students and faculty use interactive media in the classroom. Rogers (2003) warns that, at times, instead of identifying a problem first, "sometimes a perceived need sets off the innovation process in an organization, and sometimes knowledge of an innovation creates a need for it" (Rogers, 2003, p. 423). Educational leaders and faculty should utilize data found from evidence-based studies within Catholic schools to identify frameworks, systems, and processes to adopt in order to improve student learning and teaching methods when using interactive digital media in the classroom. Once problems are identified and potential solutions have been recognized, the educational team then moves to the matching stage of the innovation process.

Stage Two: Matching

Educational leaders and faculty will now align the problems identified with the potential solutions. At this stage of the innovation process, educational leaders will align the best possible solutions for the problems. For example, educational leaders and faculty deciding to effectively integrate interactive media into the classroom may decide to conduct formal professional development to build additional awareness surrounding student feedback. To illustrate this, educational leaders and faculty will appropriately fit the need for using *Mathletics*™ to provide effective student feedback with a training workshop that offers awareness of strategies to provide individualized student feedback. Matching the appropriate solution for the problem "marks the watershed in the innovation process between initiation and implementation" (Rogers, 2003, p. 424). Rogers (2003) suggested that educational leaders and faculty will make the decision to move forward with implementation of the new framework or terminate it. Finally, Rogers (2003) insisted that a new process could be retained for an extended period of time when a new framework successfully achieves a desired result.

Redefining/Restructuring

This stage requires the educational team to modify the new frameworks in order for it to meet the school's specific needs (Rogers, 2003). This study concluded that after utilizing *Mathletics*™ in the classroom, assessment data on the *math* section showed no statistically significant differences in Iowa Test of Basic Skills™ (Riverside Publishing, 2008) developmental standard scores (SS) of students where *Mathletics*™ was used by teachers and classrooms where *Mathletics*™ was not used. Providing student assessment data may help faculty assess student needs in the math classroom. At the same time, Catholic schools should be prepared to adjust existing school processes and policies in order to implement new frameworks that will resolve Internet issues, availability of computer devices, lack of data use and analysis, and the need for teacher training (Rogers, 2003). Burke (2011) insisted that educational leaders create team-building activities for faculty will that foster effective organizational change. When educational leaders and faculty collaborate on new frameworks, the new ideas will be more readily accepted and adopted (Rogers, 2003).

Clarifying

Once the new framework has been modified to meet specific needs, the team should plan to become more familiar with the new framework that will become a new process within the

Catholic school. Educational leadership could ask for final feedback on how Internet issues are handled, how to incorporate creative ways to make computer devices available for student use, how data is dispersed to faculty for analysis, and the effectiveness of training programs. Faculty could offer many constructive insights on how to design the most effective solutions. This could help engage faculty in order to foster collaboration. Rogers (2003) warned that implementing without offering time for proper planning could lead to a poor end result. Educational leaders should ensure that faculty is motivated, encouraged, and supportive to adopt the new frameworks. Without faculty support, these frameworks could fail, and lead to a rejected process.

Routinizing

The last stage in Rogers (2003) innovation process in an organization requires the team to integrate the new frameworks established through collaboration into the Catholic school's existing routine, culture and values. When this stage takes place, the stages of the process are considered complete. Rogers (2003) noted that new frameworks may be retained when educational leaders and faculty transform and embrace the frameworks that align directly to school needs that resolve computer issues, access and availability of technology, create ways to analyze data, and implement professional training about interactive media in the classroom. At this point, new frameworks may also be terminated (Rogers, 2003).

Internal/External Issues Related to Proposed Solution

Internal and External policies related to new frameworks proposed in this study may affect or influence the use of interactive media in the math classroom. Issues within the Catholic school setting may negatively affect the use of interactive media in the classroom. Educational leadership and faculty are critical participants in driving effective change in order to improve the use interactive media in the math classroom.

The results of this study concluded through faculty perceptions that students show excitement when interactive media is used in the math classroom and students find that *Mathletics*™ is a fun and exciting way to learn math. Faculty respondent T5 acknowledged "*Mathletics*™ gives them opportunity to practice in a fun way, so they are more open and positive to math in general…" (Teacher Participant T5). A Faculty respondent also indicated that *Mathletics*™ is a great way for students to practice basic math. Faculty respondent T12 noted "…the fact they are excited about learning those basic facts, getting them, memorizing them, and doing them quickly, which is what the live, *Mathletics*™ portion really focuses on, has really made a huge difference in that they can do the lessons and are more successful in the lessons. It has definitely made huge improvements with that and I just believe that basic math fact knowledge; if you don't have that, you can't do any of the higher math" (Teacher Participant T12). Furthermore, interactive media in the math classroom is best used as a supplemental program along with the school's math curriculum. Faculty respondent T2 highlighted "I think it improves it because they like it, they enjoy it… I can choose the concepts that the students are working on in the classroom with our textbook and the ones that I am trying to hit for the standards and I can pick out the assignments for that they can practice in the classroom and at home…And parents like it because it's a safe way, safe place for them to go on and learn math, practice math… Also, I do put out like for homework, in terms of homework, since we are doing multiplication, I tell the kids "Go on 10 minutes of anything," and they can choose *Mathletics*™ if they like to practice their math facts with those songs. So that's helpful" (Teacher Respondent T2). Interactive media that is used to replace classroom curriculum may result in a negative effect on student learning.

Another issue related to improvement of student learning and teaching methods utilizing interactive media is students that perceive computers and digital learning tools as a game rather than a learning opportunity. Faculty respondent T9 commented "They sometimes approach it as a game instead of serious work. I think when they get their score at the end of the *Mathletics*™ segment, and maybe they didn't do as well, it doesn't affect them as much as if I handed them a paper that had a 30% on it or something…" (Teacher Participant T9).

Faculty should design effective teaching game-based strategies that directly align with the common goals and standards of the school.

Technology advances constantly change the landscape of education. Teaching methods may need to be transformed to meet the changes in technology. This could be very costly for educational institutions. Catholic schools may be required to search for additional financial resources to meet the needs of technology changes. This includes updated hardware, software, and new devices.

Another issue related to new frameworks that support student learning and teaching methods when interactive media is used in the math classroom are new and revised state standards. Results of this study indicate that the Common Core State Standards align with *Mathletics*™. As technology and educational expectations change, educational leaders should be prepared to re-establish new frameworks that align with future state and federal standards. Establishing new frameworks for the proposed solution in this study may help prepare students for life when they graduate high school and enter college.

Summary

This chapter presented two distinct parts of this study: (1) reporting the results of the data collection and (2) presenting the evidence-based solution to the problem outlined in the study.

Results of Data Collection

This study used data collected from student assessment scores and faculty interviews to determine whether or not *Mathletics*™ improved student learning and teaching methods at three private, Catholic schools in Florida. Student assessment data showed no statistically significant difference for the *math* sections and a statistically significant difference on standardized test scores for the *computation* sections of 6th grade math students prior to the implementation of *Mathletics*™ than 6th grade math students after the implementation of *Mathletics*™

It was apparent that faculty perceptions indicated that *Mathletics*™ positively impacted student learning and teaching methods in the math classroom. One faculty participant noted "I think the biggest benefit I have noticed is that they are excited to do math and especially their basic math facts/computation has really increased" (Teacher Participant 12). Information collected from faculty interviews emphasized that *Mathletics*™ was a benefit to classroom instruction; motivated and engaged the learner; was an effective supplementary digital tool for extended practice; aligned with core curriculum and math standards; provided ways for faculty to differentiate learning, individualize learning, and provide instant feedback. One faculty participant highlighted "you can see what you did wrong immediately (Faculty Participant 7). It was also evident from faculty perceptions that faculty needed a systematic process to improve computer issues, availability of technology, data to inform instruction, and professional development. One faculty participant warned "I don't feel I really had the training to use what's being presented to me that not as much as I could have" (Teacher Participant 8).

Evidence-Based Solution to the Problem

Three solutions were presented to improve the use of interactive media in the math classroom: (1) processes for Internet issues, (2) developing innovative ways to incorporate or share computer devices, (3) providing faculty with student assessment data to improve student performance, and (4) professional training. Implementing processes to assist faculty in resolving computer and Internet related issues while students are using interactive media. For example, the educational team could devise centralized work- flow processes to support faculty in resolving Internet connection issues. Develop innovative ways to resolve issues surrounding availability of computer devices. For example, students can share computers when utilizing *Mathletics*™. To help guide faculty in making critical decisions about student achievement, educational leadership should provide current assessment data. Analyzing assessment data can guide faculty in providing ways that interactive media can be used for corrective instruction and modifying teaching approaches to individual student needs. Ongoing teacher development was presented as a solution to offer faculty a way to learn ways to effectively utilize emerging technologies in the classroom. Ongoing faculty development should be hands-on, experiential, and collaborative. Faculty respondent T9 emphasized "The biggest thing with any part of them with that is I think is that you have to sit down and just explore yourself and go through all the different tabs and what they offer because there is always more to find and until you actually, we sit through teleconferences or we get emails about updates but until you are actually in there and signed on and you are clicking and using it, it is really hard to just take it from a teleconference if you are not looking at it at that time" (Teacher Participant T9). Faculty respondent T7 also noted "I think with the training, when you haven't play with it yet, it's hard to even really know what they're talking about. I'm a person that has to sit down and just mess with it before I can" (Teacher Participant T7).

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

Introduction

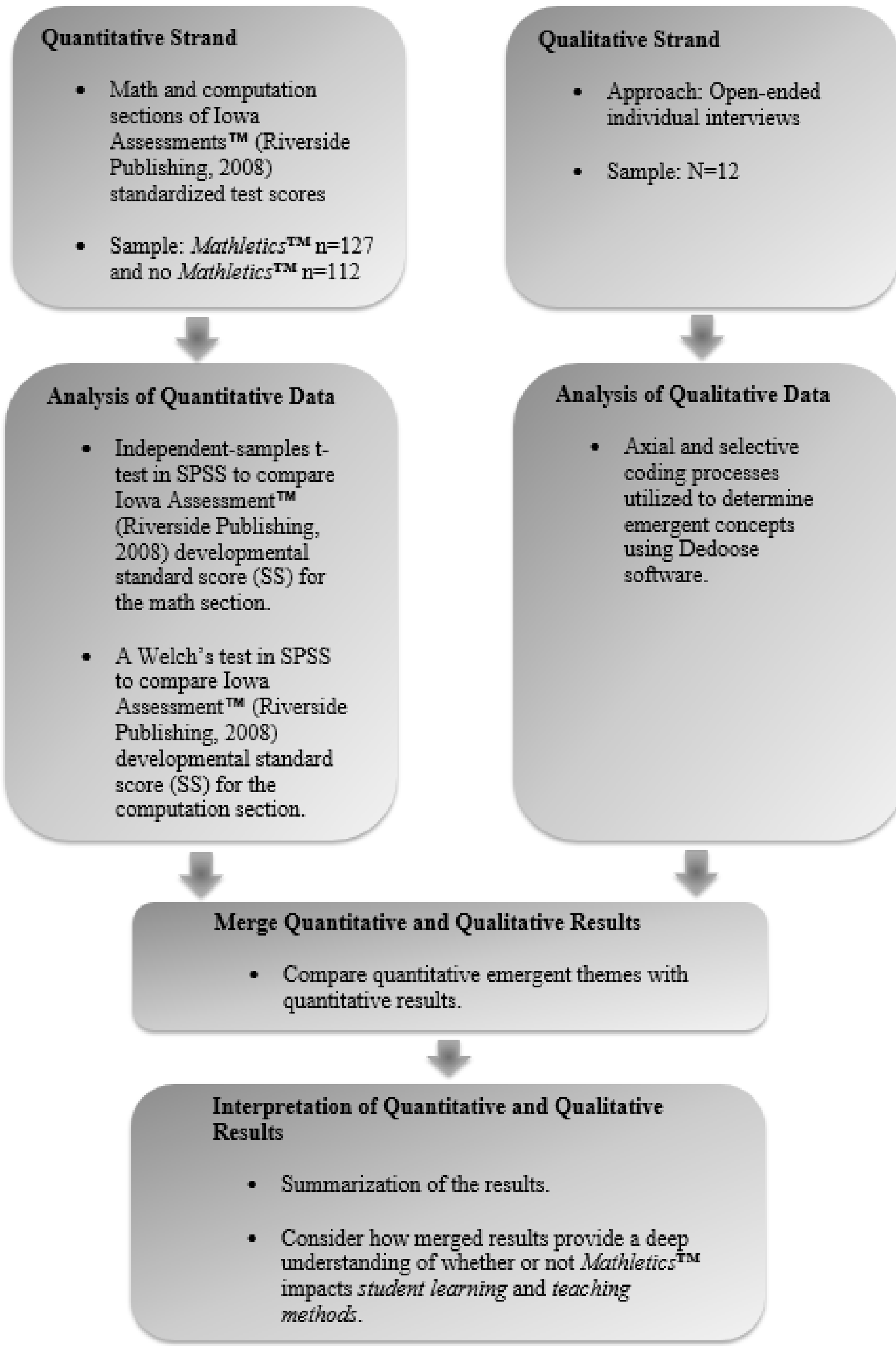
The purpose of this study was to determine whether, *Mathletics*™, improved student learning and teaching methods at three private, Catholic schools in Florida. There is a need to measure and explore whether or not interactive media impacts the math classroom (Zhang et al., 2015; Robin, 2008). Research studies that examine and explore the impact of interactive media in schools provides educational leaders with the rationale to use financial resources for technologies and faculty training (Roblyer, 2016). This study was intended to investigate whether or not *Mathletic*s™ impacts *student learning* and *teaching methods* and provide solutions based on research findings to schools utilizing interactive media in the math classroom. Assessment and interview data were collected to measure and explore the impact of *Mathletics*™ on the Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores to determine the impact of student learning and teaching methods in the math classroom. Conclusions from the data of this study disclosed that *Mathletics*™ improved student learning and teaching methods in most cases; however, there is a need to incorporate policies and procedures to resolve Internet issues, increase faculty awareness around assessment data to analyze student performance, and provide interactive media training opportunities for faculty.

This chapter will discuss conclusions, implications, and recommendations for this study. Potential solutions offered to leaders of Catholic school education for this study include developing and integrating policies and procedures to improve how educational leaders and faculty resolve Internet issues when utilizing interactive media in the math classroom, developing a systematic framework to provide ongoing assessment data to faculty in order to help them gain critical information needed to gauge student performance, and integrating effective professional developing strategies for how to integrate interactive media in the math classroom.

Summary of the Study

In comparison to other countries, students in the U.S. are below average in math (Tucker & Darling-Hammond, 2014). A critical issue that persists in K-12 schools is whether or not interactive media impacts education (Delgado, Wardlow, McKnight, & O'Malley, 2015). As technology continuously advances, it requires schools to adapt to these changes so that students are prepared for college and careers (Delgado et al., 2015). Technologies that exist in K-12 environments are not always incorporated in curricula (Ozel et al., 2008). This study examined the impact of *Mathletics*™ on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores and explored faculty's perceived impact of *Mathletics*™ on student learning and teaching methods in the math classroom. The study also provided evidence-based solutions to whether or not *Mathletics*™ improves student learning and teaching methods in math classroom environments.

A Convergent parallel mixed methods approach was used for this study. Figure 4 is a visual model illustrating the convergent parallel mixed methods approach used for this study.



Adapted from Creswell & Plano Clark (2011)

Figure. *4*. Visual Model illustrating the convergent parallel approach.

A comparison of assessment data from two iterations of 6th grade learners that received *Mathletics*™ and 6th grade learners that did not receive *Mathletics*™ was used to determine whether there was a statistically significant difference between student scores. Interview data from 12 faculty members were also collected through a standardized protocol to explore the perceived impact of *Mathletics*™ on *student learning* and *teaching methods*. Triangulation was used to find consistencies and inconsistencies in the results of assessment data and faculty perceptions to strengthen the study (Creswell & Plano Clark, 2011). Finally, this study devised a plan to aid in addressing evidence-based solutions.

Student results from Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores revealed a statistically significant difference on the *computation* section and not a statistically significant difference on the *math* section between one group of 6th graders at three Catholic schools in Florida that received *Mathletics*™ and one group of 6th graders at three Catholic schools in Florida did not receive *Mathletics*™.

Faculty interviewed for this study highlighted a positive impact on both student learning and teaching methods in the math classroom. Faculty noted that *Mathletics*™, when used as a supplemental digital tool, (1) generated excitement about math, (2) was a fun resource, (3) motivated students to learn, (4) was challenging, (5) increased participation, (6) fostered healthy competition among students, (7) provided extra practice and repetition, (8) individualized learning, (9) supplemented existing instruction, (10) aligned with math curriculum and Common Core Standards, (11) individualized learning, (12) and provided opportunities for instant feedback. However, faculty also cautioned that although *Mathletics*™ positively impacts student learning and teaching methods, additional teaching and learning policies and procedures beyond the use of *Mathletics*™ that support students and faculty should be implemented and integrated. Faculty noted Internet and computer issues when using *Mathletics*™ in the classroom. These issues included logging on to *Mathletics*™ and availability of computers. Faculty also emphasized that tracking math trends to monitor student progress essential, thus, the need for reporting data to gauge student progress. Faculty highlighted the need for professional development in order to effectively integrate interactive media in the classroom. Faculty suggested that they need more hands on practice using the supplemental digital tool, exploring the tool in more detail, and becoming more prepared when using interactive media in the classroom. Seven qualitative themes emerged from interview data as a result of this study: (1) Interactive Media Usage in Math Instruction, (2) Student Motivation and Engagement in Learning, (3) Utilization of Data to Inform Instruction, (4) Extended Practice, Repetition, and Reinforcement, (5) Professional Development, (6) Meeting Expected Math Skills and Standards, and (7) Principles and Methods for Math Instruction.

The following policies and procedures are evidence-based solutions based on the seven resulting themes. (1) Incorporating frameworks to timely resolve Internet issues can improve interactive media usage in the math classroom. Educational leaders and faculty could track common issues relating to Internet usage and devise effective frameworks to improve how interactive media is used in the classroom. (2) Educational leaders and faculty may also devise procedures to share computer devices between students during interactive media use. Flipped classroom models that allow students to utilize interactive media at home before and after class and bringing your own device (BYOD) to school are also helpful solutions (Roblyer, 2016). (3)

Educational leaders could also implement processes to collect student assessment data and provide the data to teachers in order to guide instruction and improve student learning. Providing assessment data could offer critical information in order to help guide faculty to determine individualized learning and identify areas for student improvement. (4) Faculty interview data also revealed the need for professional development to provide teachers with ways to utilize *Mathletics*™ in the math classroom. A designated teacher leader from each school could provide best practices of the utilization of *Mathletics*™ to other faculty to improve the way interactive media is used in the classroom. Educational leaders can also provide opportunities for faculty to reflect during training programs to transform student learning and teaching methods in the classroom (Saylor & Johnson, 2014). This would help prepare teachers for ongoing use of interactive media in the classroom.

Purpose of the Study

The purpose of this convergent parallel mixed methods study was to determine whether, *Mathletics*™, a supplemental digital math tool, improves *student learning* and *teaching methods* at three private, Catholic schools in Florida.

Aim of the Study

The aim of this Dissertation in Practice was to determine whether or not *Mathletics*™ improved *student learning* and *teaching methods* in the 6th grade math classroom and created evidence-based solutions for school leaders from the research findings.

Implementation of Solution Processes and Considerations

Potential solutions for this study have not been implemented within private, Catholic schools sampled within the state of Florida; however, this section will discuss recommendations that educational leaders and faculty may utilize for implementation of the proposed solutions.

Roles and Responsibilities of Key Players in Implementation

School principals are integral in implementing the proposed solutions of this study. School principals have authority to guide new ideas, processes, and frameworks for school improvement. The overall responsibility of the Catholic school principal is establishing an overall vision for the school by "…developing a Catholic school culture, identify needed changes, supervise instruction, provide for the individual needs of the students, and exhibit leadership in curriculum development" (Schafer, 2004, p. 247). The principals would act as the leader of initiatives to improve *student learning* and *teaching methods* through interactive media. School principles may consult with the Parish office and Diocesan School Board to ensure these roles and responsibilities align with resolving the proposed solutions. Proposing and adopting new policies and procedures that improve *student learning* and *teaching methods* in the math classroom is not easy (Rogers, 2003). Principals should involve faculty during the implementation process so they are more committed to adopting the new policies and procedures (Burke, 2011).

Faculty members are an integral component in implementing the proposed solutions. Faculty become exemplars when they effectively utilize interactive media during classroom instruction (Roblyer, 2016). Faculty may become effective role models to the use of technology in the classroom by sharing best practices with other faculty (Roblyer, 2016). Expert Faculty role models provide proficient learning environments "…that generates an atmosphere of trust…" (Hattie, 2012 p. 29). Along with the principal, faculty share a critical role in the integration of interactive media for all students in the learning process. For example, faculty may integrate interactive media in the classroom to provide differentiated instruction opportunities to students of various learning levels (Ozel et al., 2009). Faculty members could collaborate with their principal to ensure a shared vision of the proposed solution so that it is directly aligned with solving the problem.

Leader's Role in Implementing Proposed Solution

Educational leaders have a significant role in implementing the proposed solutions for this study. A leader's role for this proposed solution would be to implement and initiate the proposed solutions to improve how *Mathletics*™ is used in the classroom. To implement the proposed solution, a leader would possess attributes with high ethical standards that are associated with the transformational leadership style: ethical, inspirational, positive, and trustworthy (Johnson, 2012). The leader would act as the coach to mentor, motivate, and educate faculty toward adopting new policies and procedures for the proposed solutions. Educational leaders would also have the responsibility for obtaining financial resources in order to implement the proposed solutions. For this study, a successful leader would be committed to the Jesuit's "Four Pillars of Success: self-awareness, ingenuity, love, and heroism" (Lowney, 2003 p. 9).

Prior to implementing new strategies, leaders could generate motivation for the newly adopted framework in the initial stages of implementation to help effectively drive the rest of the steps in the process (Rogers, 1995). Goldring, Mavrogordato, & Hayndes (2015) noted that it is critical that educational leaders receive performance feedback during the evaluation process to improve K-12 practices. During implementation of the proposed solutions, educational leaders could continuously seek feedback from faculty members, staff, and other stakeholders to build awareness of the effectiveness of the proposed solutions. This policy might keep faculty engaged and motivated concerning the adopted changes. Goldring et al. (2015) recommended that school administration could devise workshops for educational leaders to practice receiving feedback in order to manage negative comments. During this phase, leaders should consider constant collaboration among faculty members. Rogers (1995) suggests that a school is a “stable system” (p. 433) when every member of each school works collectively rather than individually to implement new frameworks to solve problems. Leaders would work with faculty to continuously drive needed changes to already working frameworks to align with technology advances. Finally, after implementation, leaders would evaluate the proposed solutions to determine its effectiveness and communicate the findings of the evaluation to teachers, parents, and administration.

To implement the proposed solution, a leader would possess attributes that are associated with the transformational leadership style: ethical, inspirational, positive, and trustworthy (Johnson, 2012). The leader would act as a champion to motivate teachers that may be resistant to the new instructional technology ideas and innovations (Rogers, 2003). The educational leader will need to encourage the use of the social cognitive theory to model desired student behaviors in order to motivate students to learn and impact student self-efficacy (Roblyer, 2016). After the proposed solutions are implemented, the educational leader, specifically the principal, would organize roundtable meetings to gain faculty feedback in order to make future changes to the proposed solutions.

Evaluation and Timeline for Implementation and Assessment

For this study, each proposed solution must have an implementation plan and assessment plan. Four solutions were proposed in the study to improve the way interactive media is used in the classroom: (1) developing a process to resolve Internet issues and lack of technological equipment, (2) providing ways to make computers available to students, (3) providing data to faculty to inform instruction, (4) and developing training solutions to effectively integrate interactive media use in the classroom. Feasible timelines for each proposed solutions may vary, but require at least one year or more to implement. Rogers (1995) argued that the initial stage alone would "…require an extended period of time…" (p. 422). Implementation requires thorough planning and quality execution.

The proposed solutions would be implemented in stages and follow Rogers, 2003 five stages in the innovation process in organizations: Agenda-setting, Matching, Redefining/Restructuring, Clarifying, and Routinizing (Rogers, 2003). Implementing new frameworks in Catholic schools in stages would provide the educational team opportunities to strategically plan and execute while allowing enough time for every step of the process. Rogers (1995) suggests that when proposed solutions begin to be recognized as part of the school's plan, moving too quickly could have "disastrous results" (p. 427). Thus, for this study, leaders should allow time for the proposed solutions to be incorporated in the school's environment.

An assessment process would be devised to collect information about the impact of the proposed solutions had on the problem to determine future decisions that affect student learning and teaching methods (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). Educational leaders would assess whether the proposed solutions impacted the identified problems in this study: Internet issues and availability of computers; lack of data to inform instruction, and the need for professional development. Educational members would do so by gathering evidence through faculty and student feedback, drawing conclusions about whether the proposed solutions impacted the problem, and determining whether the proposed solutions should be changed to meet student needs and technology changes.

Although commonly used for Higher Education assessment, Walvoord's (2010) Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved, Three Steps of Assessment may be applied to examine the effectiveness of Internet issues and computer availability processes and data analysis procedures: (1) Goals, (2) Information, and (3) Action. Kirkpatricks's (2006) Four Level Training Evaluation Model may be applied to evaluate the effectiveness of professional development training programs: Reaction, Learning, Behavior, and Results. The education leaders may utilize the following assessment and evaluation plans after putting the proposed solutions into action.

Assessing Internet Issues and Computer Availability Procedures

Assessing Internet issues and computer availability procedures could be the first step in the assessment process. Educational members could then set specific student outcomes. For this study, faculty members emphasized student issues when logging in to the *Mathletics*™ portal and lack of availability of computer devices when using *Mathletics*™ during class times. To illustrate this, teachers commented that students had difficulties remembering their usernames and passwords to *Mathletics*™ and not having enough computer devices when utilizing interactive media during class times. In this step, educational leaders may gather faculty feedback through surveys, roundtables, or discussions, on how interactive media is used in the classroom, its usability, and availability to determine what the student should know after the procedure is implemented (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). Examples of outcomes would include a reference sheet placed on each computer with specific login instructions and a pairing of student system for computer utilization. The second step requires educational members to collect information to determine the benefits of the implemented processes (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). This may be done by gathering information on how many times a student was unsuccessful logging in and documenting the pros and cons of device sharing when utilizing *Mathletics*™. The last step of this process requires educational leaders to analyze the information collected. Through reflection, educational members would determine what worked well, what didn't work well, and what processes need improvement. Best practices could be shared through an educational roundtable. Educational members may need to develop new plans or requirements based on the findings of the analysis of information to effectively provide procedures for Internet issues and availability of computers.

Data Utilization to Inform Instruction

Data utilization to inform instruction could require educational members to schedule roundtable discussions to fine tune goals or develop plans for analyzing assessment data to improve student achievement through interactive media (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). For this study, faculty interview themes included having lack of assessment data to determine whether interactive media improved student learning and teaching methods. Examples of data utilization goals when using interactive media may be using assessment data to measure growth of individual learning or whole grade level learning, comparing monthly or yearly assessment data, and comparing student assessment data to the previous school year. The second step requires educational members to collect student assessment data to measure student assessment performance (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). Faculty may also collect other forms of assessment to determine whether student learning and teaching methods have improved when interactive media is used in the classroom: class observations, weekly tests, and homework. The last step requires educational leaders to utilize the assessment data to determine how to improve student learning and teaching methods in the classroom (Walvoord, 2010, Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved). Assessment data may help faculty to determine how to better integrate interactive media for the classroom instruction or individual student. It is important for leaders to reflect on this process to make continuous improvements for the future.

Professional Development

Education leaders may follow the sequence represented in Kirkpatrick's (2006) Four Level training evaluation model. Level 1 measures faculty *reactions* toward the training workshops regarding satisfaction. This step would gauge faculty reactions to see what the training programs need to include (Rogers, 2003). Members assigned to developing and implementing training programs to improve the way interactive media is used in the classroom may collect information by providing round-table discussions or using feedback forms at the end of the workshops. The purpose for collecting faculty participant reactions to training workshops is to understand how the training was received. Education leaders should collect information about whether or not the training was effective in answering faculty questions about integrating interactive media into the math classroom. Education leaders could ask the faculty participants if the topic was useful and the curriculum modules were meaningful. A survey form could be developed to quantify faculty *reactions* to the training programs.

Level 2 could measure faculty *learning* once the training workshops are complete. Learning may be measured by education leader observations to determine whether the information provided in the training workshops are being utilized in the classroom. School administration could measure whether the information is being utilized by conducting classroom observations. Kirkpatrick & Kirkpatrick (2006) suggested that an education leader determines whether or not the training programs are successful when "Attitudes are changed. Knowledge is increased. Skill is improved" (p. 22). School administration could also conduct teacher surveys and written tests to determine how teachers feel and if knowledge has increased from the training programs. School administration could focus on obtaining faculty information about whether or not knowledge was gained from the training programs, skills were improved, and attitudes were changed (Kirkpatrick & Kirkpatrick, 2006).

Level 3 measures the degree to which participants' behaviors change as a result of the training programs. In this phase, education leaders may observe faculty behaviors to determine whether or not they are applying the knowledge and skills they learned from the training workshops to the classroom. School administration could observe faculty behaviors to ensure faculty made changes in the math classroom based on what was learned in the training programs. School administration could provide rewards to faculty who have integrated the changes to the math classroom based on what was learning in the training programs. Professional development programs for faculty teaching in elementary schools that included reflective practices following the training resulted in improved teaching practices in their math and science classrooms (Saylor et al., 2014). Faculty could utilize reflective practices after the training programs are complete to determine whether positive faculty behaviors about technology integration could be effectively transferred to the math classroom (Saylor et al., 2014).

Level 4 seeks to determine the *results* of the training programs: reduced cost, improved use of technology in the math classroom, more effective training methods, and increases in student learning and teaching methods. At the fourth level, education leaders should analyze the data collected from the final results of the training process. Education leaders may use observations, student assessment results, and faculty feedback to measure overall improvement of the training programs. School administration could measure the *results* of the training program by examining the math classroom before and after the training programs are conducted. Positive results to properly integrating technology into the teaching of mathematics for young learners includes "…improved attitudes toward learning, increased student achievement and conceptual understanding, and engagement with mathematics" (Ozel et al., 2008 p. 81)

Convincing Others to Support The Proposed Solution

Gaining support for the proposed solutions for this study is critical. Educational leaders could gather information and clearly explain faculty expectations of the proposed solutions in order to reduce the "…degree of uncertainty and perceived risk…" (Rogers, 1996 p. 35). All members of each school system should support and encourage the new frameworks proposed in this study for it to be successful. Rogers (1996) argued that implementing new frameworks is no easy task. Burke (2011) noted that attempting to propose new changes to school structures could be difficult if the organizational members do not understand the reason for a change.

Burke (2011) discovered that resistance to change is increased when individuals feel forced to change without buy-in concerning their values. Thus, educational leaders may face potential obstacles when attempting to implement the proposed changes. Burke (2011) suggested that problem-solving meetings to discuss the newly adopted changes and innovations were beneficial to managing organizational change. Education leaders could conduct problem-solving meetings to include participation of faculty to improve student log in processes, analysis of assessment data, and professional development programs (Burke, 2011). Acceptance of new ideas by faculty, students, parents, and the Catholic Diocese may be challenging. Faculty may disagree with the proposed change, students may be discouraged by change, parents may be concerned with how the change may affect the students, and the Diocese might be concerned with financial and time constraints that effect may pose a threat to the proposed changes. Leaders that engage the local school community, particularly, faculty, students, parents, local businesses, and other stakeholders can meet technology school improvement goals more effectively

(Roblyer, 2016). Leaders could involve school stakeholders of the local community by conducting public forums to discuss strategies for the integration of interactive media that improve student learning and teaching methods in the math classroom (Roblyer, 2016). Leaders could also generate buy-in for the proposed solutions by holding public meetings to effectively communicate the proposed change to all stakeholders of the local community and mentoring faculty to become exemplars of change.

Holding public meetings that involve the entire school community could have an impact on effectively communicating and initiating the proposed solutions for this study (Roblyer, 2016). Faculty participants emphasized concerns for Internet issues, availability of technical devices, lack of data to inform instruction, and lack of professional training to impact student learning and teaching methods. Educational leaders may achieve commitment by communicating faculty concerns and proposed solutions to stakeholders by sharing how, when, and why the new frameworks must be implemented during public forums. Information about the implementing of the proposed solutions may also be discussed to stakeholders through information sessions, written letters, and online discussion boards.

School leaders could motivate faculty by consulting with faculty and providing data driven evidence that change is needed before implementing decisions toward school improvement that directly affect faculty (Hattie, 2012). For this study, faculty should act as role models to guide students through the proposed change. Faculty motivation surrounding the proposed changes may help support the implementation process. For this study, a transformational leader inspires others by listening and acknowledging student needs (Johnson, 2012). Transformational school leaders could inspire their faculty and staff by working together to meet the goals concerning the changes needed to implement the proposed solutions (Hattie, 2012). Leaders could work with faculty by conducting team-building activities that foster effective ways to implement and support the goals of the proposed solutions. Through transformational leadership, educational leaders and faculty are accountable for ensuring the proposed solutions are planned, implemented, and evaluated effectively (Johnson, 2012).

Critical Pieces Needed for Implementation and Assessment

Funding could be a significant challenge for leaders attempting to implement the proposed solutions for this study (United States Department of Education Office of Educational Technology (n.d.). Funds to purchase computer devices and digital tool membership fees are necessary. Schools would need to ensure each computer device and digital software is updated to the latest technology. Updating technology to schools could be an ongoing expense for the school. Educational leaders may discuss technology needs with the diocese to obtain funding. School leaders may also develop fundraiser opportunities or search for technology donor programs to gain financial access for digital tools. The United States Department of Education Office of Educational Technology (n.d.) recommends that school leaders find creative solutions to fund educational technologies in schools. For example, schools could determine whether existing processes, procedures, and digital tools are no longer useful and allocate those financial resources to replace newer technologies (United States Department of Education Office of Educational Technology, n.d.).

Ozel et al. (2008) suggested that student math performance could be improved when technology is effectively integrated in the math classroom. Saylor et al. (2014) noted that reflective practices toward the end of effective professional development programs resulted in improvements to student learning and teaching methods in our schools. Educational leadership could continuously provide professional development opportunities that include reflective practices for faculty in order to effectively integrate interactive media in the math classroom. Educating faculty with digital tools for improving student learning and teaching methods may help each school to create an environment of continuous improvement and student achievement. Educational teachers, along with faculty and parents, should continuously share ideas to improve student learning and teaching strategies regarding interactive media in the math classroom. New ideas such as the proposed solutions for this study could be adopted into school curriculum to create improvement. Quarterly meetings to discuss planning, implementing, and assessing of newly adopted ideas would be critical to the success of the proposed solutions. For example, educational leaders could utilize Rogers' (2003) five stages in the innovation process in an organization for the implementation of new frameworks in the math classroom, Walvoord's (2010) Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved, Three Steps of Assessment to examine the effectiveness of Internet issues and computer availability processes and data analysis procedures, and Kirkpatricks's (2006) Four Level Training Evaluation Model evaluate the effectiveness of professional development training programs.

Internal and External Implications for the Organization

Implementing policy structures to improve Internet issues and computer availability, incorporating frameworks to provide faculty with opportunities to analyze student data to impact instruction, and allowing ongoing educational opportunities for faculty to learn about effective ways to incorporate interactive media in the classroom is the first step in improving student learning and teaching methods in the math classroom. Ozel et al. (2008) suggested that effective integration of technology in the math classroom could positively impact student math performance. Roblyer (2012) argued that although research is not clear how constructivist models of teaching are effective on addressing federal content standards, inquiry-based constructivist models used in the classroom are more innovative than the traditional style of teaching and learning. Schools innovatively using interactive media in the classroom and have implemented the proposed solutions may offer best practices including how to obtain funds to technology in the classroom, how to effectively utilize personnel, and gain buy-in to implement new ideas to schools that are in the process of attempting to effectively integrate digital tools in the classroom. New computer related policies, data analysis procedures to improve student achievement, and professional development programs may be shared with other schools for continuous improvement. Implementing technologies such as interactive media in the math classroom with the proposed solutions could help develop the 21st century skills needed for college preparation and careers (Delgado, 2015). The proposed solutions could also improve educational leader and faculty awareness about whether or not interactive media improves student assessment scores and offer faculty professional development that is impactful to student learning and teaching methods at a Diocese or national level.

At a broader view, implementing the proposed solutions may also impact student learning and teaching methods to improve overall national assessment scores. Tucker &D Darling-Hammond (2011) recommended that one way to improve student performance is to provide faculty with opportunities to develop their professional teaching skills in order to identify issues related to student needs and create methods to resolve them. Jackson et al. (2013) suggested a positive impact on student learning motivation and student attitudes when interactive media, specifically interactive tabletops, were used to aid instruction in the math classroom. Incorporating interactive media and the proposed solutions may be impactful if implemented in all Catholic schools. It may also provide schools with frameworks that allow for continuous improvement in student learning and teaching methods.

Implications and Considerations for Leaders Facing Implementation of Proposed Solution

The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project highlights that education leaders are faced with six major challenges when attempting to effectively implementing technologies in K-12 environments: (1) lack of professional development, (2) resistance to change and adopting new ideas, (3) the need to utilize new models of 21st century learning, (4) failure to blend formal and informal instruction, (5) the need for individualized learning, and (6) failure to use innovative technologies to deliver assessments. School leadership could continuously provide ongoing *professional development* programs that are designed to inform faculty on how to create new curriculum, update learning outcomes, and improve teaching strategies to align with technological advancements. School leadership will need to champion efforts that would motivate faculty, students, parents, and other stakeholders who are *resistant to change* to adopt new policies and procedures that require the integration of effective technology in Catholic schools. Schools could utilize new learning models and innovative ways to deliver quality math instruction. MOOCs are an example of *new models of teaching* and learning that could be incorporated in the K-12 education (The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project, 2012). Catholic schools could address the effective use of blending formal and informal models of learning in the math classroom. The flipped classroom is an example of how schools can utilize blended learning effectively (The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project, 2012). The flipped classroom could allow students to review video lectures while at home prior to engaging in classroom discussions, exercises, and experiments. Schools could seek to provide digital tools that support individualized learning and differentiated instruction (The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project, 2012). Finally, schools should implement strategies to align changes made to curriculum to include technology driven assessments (The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project, 2012). The NMC Horizon Report: 2013 K-12 Edition (2013) by the New Media Consortium and part of the Horizon Project, (2012) recommended using webcams to observe faculty in order to provide feedback that would improve teaching methods and practices.

Educational leaders may also face ethical challenges when incorporating interactive media and the proposed solutions for this study: computer hacking, privacy issues, plagiarism, piracy, cyberbullying (Roblyer, 2016). Leaders of schools may be required to develop and implement new policies for ethical behavior when using interactive media in the classroom. Students should be considerate and respectful when using interactive media as a social platform. Software platforms, such as *Mathletics*™, interact with other students all over the world. Developing student guidelines that include expectations of appropriate computer use for faculty and students is imperative. Acceptable Use Policy (AUP) agreements should be required to enforce appropriate uses and integration of technology while school is in progress (Roblyer, 2012).

Evaluation Cycle (or Evaluation Cycle Outcome If Implemented)

An evaluation cycle should be implemented for the proposed solutions to be effective. The goal of the evaluation cycle for this study is to assess the effectiveness of the proposed solutions. Walvoord's (2010) Copyright © 2010 by John Wiley & Sons, Inc. All rights reserved, Three Steps of Assessment will be utilized to examine the effectiveness of Internet issues and computer availability processes and data analysis procedures, and Kirkpatricks's (2006) Four Level Training Evaluation Model will be utilized to evaluate the effectiveness of professional development training programs. The initial evaluation cycle should begin after 6 months of the proposed solutions' implementation and should continue to be evaluated every 6 months. This will allow time for the proposed solutions to be integrated in curriculum, and provide time for faculty and students to adopt the new working frameworks and apply the new knowledge and skills learned from training workshops regarding the use of interactive media in the math classroom. The evaluation cycle may include questions that determine whether interactive media impacted student achievement and teaching strategies, whether teachers are incorporating the proposed solutions by conducting observations conducted by educational leadership, whether the proposed solutions were effective in impacting student learning and teaching methods, and training rubrics for assessment of professional development programs. The information obtained from evaluating the proposed solutions will help leaders make future decisions about interactive media use in the classroom. Principals should utilize distributed leadership practices by generating collaborative discussions and gathering feedback through interviews from multiple sources including students, faculty, and parents to obtain insights regarding school improvement initiatives (Kelley & Dikkers, 2016). Communication and feedback from multiple sources will provide insights on how to make future improvements to school curriculum. Future improvements may include improving frameworks for Internet issues and creating innovative ways for computer sharing, collecting other assessment data to inform instruction, and updating professional development training programs to include new technology advancements.

Summary of the Study

This study found that when *Mathletics*™ was used in the math classroom, there was a potential that is could impact student learning and teaching methods. The use of *Mathletics*™ in a the 6th grade classroom indicated there was not a statistically significant difference in the developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the math sections of 6th grade math students; however there was a statistically significant difference in the developmental standard score (SS) for Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized test scores for the computation sections of 6th grade math students. A Cohen's d effect size indicated a practical difference between the standard value of small and medium (r = -.207). Although, Cohen's d test indicated a small effect size, Hattie (2012) emphasized that "for any particular intervention to be considered worthwhile, it needs to show an improvement in student learning of at least an average gain – that is, an effect size of at least 0.40" (p. 3). *Mathletics*™ could have impacted computation scores rather than math scores for two reasons: (1) Interactive media helps to support basic math skills. Roblyer (2016) emphasized that technology resources in math education are a critical component for students to practice basic math skills. Students that become proficient in basic math skills build the necessary skills for higher –order math skills (Roblyer, 2016). (2) The ideas and beliefs of faculty based on the results of this study indicate that faculty, in general, utilize interactive media for reinforcement and practice of basic math skills. The study also revealed that faculty need additional training on how to better utilize interactive media in the classroom. Ozel et al. (2008) highlighted that teachers could utilize technology in the math classroom for differentiated learning and to create strategies for individualized instruction. However, Ozel et al. (2008) noted that digital technologies are not always utilized and integrated within mathematics classroom instruction even though schools make digital technologies available for students to utilize during school hours. Professional development programs for faculty could help develop faculty knowledge concerning the integration of technologies in the math classroom to impact higher – order math skills.

This chapter also highlighted a need for educational leaders to implement three proposed solutions to further impact student learning and teaching methods when interactive media is used in the math classroom. Faculty comments revealed a need to improve processes for *Internet issues* and *availability of computers in the classroom environment*, provide faculty with *assessment data* to improve instruction, and facilitate *professional development* to build awareness and proficiency in interactive media platforms so teachers can improve teaching strategies and curriculum.

Internet related issues and computer availability was a faculty concern. Implementing processes to improve student log on issues and providing creative ways to utilize a shortage of computers is critical to improve student learning and teaching methods in the math classroom. Providing faculty with annual assessment data to inform instruction would also be needed to improve student learning and teaching methods when interactive media is used in the classroom. Finally, educational leaders should implement professional development workshops to inform faculty about the most effective ways to utilize interactive media in the classroom. Implementing professional development opportunities could be accomplished through obtaining faculty feedback about the utilization of interactive media in the classroom, and developing specific training to help improve its integration into the math classroom. Implementation of the proposed solutions would take place in steps. Walvoord's (2010) Three Steps of Assessment could be applied to examine the effectiveness of Internet issues and computer availability processes and data analysis procedures: (1) Goals, (2) Information, and (3) Action. Kirkpatricks's (2006) Four Level Training Evaluation Model could be applied to evaluate the effectiveness of professional development training programs: Reaction, Learning, Behavior, and Results. Evaluation would take place 6 months after each proposed solution is implemented. The evaluation process would be continuous and ongoing. It is educational leaders responsibility to ensure the planning, implementing, and evaluating of the proposed solutions are successful.

Implications for Action/Recommendations for Further Research

The significance of this study offered frameworks for educational members to utilize in order to impact the overall use of interactive digital media in the math classroom. Studies that include whether or not multimedia and digital storytelling benefits the K-12 classroom are essential (Robin, 2008). The results from this research revealed that although interactive digital media impacted student learning and teaching methods, faculty also experienced obstacles while utilizing interactive digital media in the classroom environment.

The research presented in this study revealed a statistically significant difference on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) *computation* scores when *Mathletics*™ was used in the classroom. The research also indicated that *Mathletics*™ yielded positive results when added to the math classroom. *Mathletics*™ encouraged student engagement, participation, and collaboration. Faculty commented that students were motivated and excited to use *Mathletics*™ because the digital tool was a fun and exciting way to learn, it rewarded student achievement, and was competitive and collaborative. Robin (2008) acknowledged that motivating students to learn is a critical component to educators and policy makers in educational environments. Robin (2008) also noted that faculty could engage learning and foster student motivation by utilizing technologies like digital storytelling in the classroom. Furio, Juan, and Vivo (2015) argued that mobile game-based learning impacted student motivation in comparison to the traditional style paper and pencil style of learning. Mobile game-based learning could be used as a supplemental digital tool in the math classroom to reinforce instruction. Hung, Hwang, and Huang (2012) suggested that students were more motivated to learn, improved problem-solving skills, and overall performance when project based digital storytelling was implemented in the science classroom.

Collaborative learning through web-based applications has the potential to impact student analytical thinking, teamwork, and individual learning (Neo, 2003). The research also indicated that *Mathletics*™ benefited student learning and teaching methods when it was used for extended practice, repetition, and reinforcement. Musti-Rao & Plati (2015) noted that students improved math fact fluency when utilizing iPad applications in the math classroom. Musti-Rao & Plati (2015) also suggested that faculty could utilize technology like iPad applications as a supplementary digital tool in the classroom to improve math skills. Highlights of this research also revealed *Mathletics*™ aligned with curriculum used in the math classroom and expected math standards. Roblyer (2016) emphasized that with the use of technology resources, faculty could utilize technology integration strategies that align with the Common Core State Standards in mathematics: (1) using interactive applications to improve student learning of mathematical concepts, (2) provides the student with a visualization of mathematical concepts, (3) encourages problem solving skills (4) provide data analysis exercises for students, (5) fosters communication and social learning interactions, (6) increases motivation by providing students with math practice, reinforcement, instant feedback (7) and provided faculty with online resources to integrate into the math curriculum. The researcher captured stories from faculty of how *Mathletics*™ accommodated differentiated ways of learning, fostered individualized student learning, and provided instant feedback for students. Ozel et al. (2008) noted that technology use in the math classroom could provide a variety of differentiated learning strategies for students. Furio, Juan, Segui, and Vivo (2015) suggested that digital games on mobile devices offered instant learning feedback.

Faculty also cautioned that Internet issues, computer accessibility, lack of assessment data to inform instruction, and a need for professional development were issues. Ozel et al. (2008) recommended that educational leaders like principals should provide faculty with a technology specialist that can assist faculty with technology support issues and integration concerns presented in the classroom. Results indicated from a study conducted by Morsink, et al. (2012) that faculty acquired new skills upon the completion of a professional development program to effectively integrate technology in the classroom while using technological, pedagogical, and content knowledge (TPAK). Adopting the new frameworks proposed in this study could better prepare students for college and careers. Analyzing assessment data and utilizing the results to develop curriculum and offering knowledge to faculty through professional development opportunities to integrate interactive digital media in the classroom would better prepare faculty for impacting student learning and teaching methods. Finally, school leaders should integrate models like the Technology Integration Planning (TIP) model and appropriate technological use policies to effectively integrate interactive digital media within Catholic schools (Roblyer, 2016). The proposed solutions for this study could assist Catholic schools to improve *student learning* and teaching *methods* through effective integration strategies of interactive digital media in the math classroom.

Future research to build upon this study is needed. Compared to many other countries, students in the United States perform below average in math (The Programme for International

Student Assessment (PISA), n.d.). Furthermore, "in an increasingly technological society, "we need more teachers who are both technology savvy and child centered" (Roblyer, 2016 p. 10). Educational leaders and researchers should continue to identify issues pertaining to the implementation of new technology in the classroom, adopt new frameworks to improve the use of interactive media in the classroom, and evaluate the frameworks to continuously improve how interactive media is used in the classroom. Educational leaders must leverage new technologies by providing faculty with opportunities to help prepare students to meet the requirements of 21st century skills (Delgado, et al., 2015). As technology continues to advance, research is needed on how educational technology impacts teaching strategies in K-12 environments. (Delgado et al., 2015).

Future mixed methods research should include longitudinal studies that show positive outcomes over a long period of time (Hew & Brush, 2007). Newly adopted solutions may impact student learning and teaching methods resulting in the need for further studies. Education leaders and faculty could analyze Iowa Test of Basic Skills™ (Riverside Publishing, 2008) scores each year to track trends for a longer period time. Quantitative studies could provide meaningful insights over time to determine whether interactive media impacts assessment scores longitudinally spanning 5 to 10 years of time.

Future studies are also critical to the success of interactive media in the math classroom. This study did not capture perceptions about the impact of student learning and teaching methods of educational leaders, parents, and students. Hew & Brush (2007) suggested that future mixed methods studies should not only examine school faculty but school leadership and other stakeholders that make decisions about the integration of technology in the K-12 classroom. Capturing stories from educational leader, parent, and student perceptions of the impact of interactive media, specifically how technologies are integrated in the math classroom would build on this research. Additional qualitative data that capture school leader perceptions may also unlock new insights that may shape, transform, and reform interactive media use in the math classroom.

While this research focused on whether or not *Mathletics*™ impacted student learning and teaching methods in the math classroom. More research is needed to measure and explore the impact on initiatives that support bring your own device (BYOD) and mobile content devices (MCDs) to determine whether or not these devices impact student learning and teaching methods (Tamim, Brown, Sweeney, Ferguson, & Jones, 2015). For example, research could explore the benefits and drawbacks of two different types of MCDs used in the math classroom to determine whether or not the devices improve student performance. Exploring the various types of devices could provide a deep understanding of student learning and teaching methods with the use of supplementary digital tools toward student achievement.

Summary

Improving K-12 mathematical performance in the U.S. is a focus for educational leaders. According to TIMSS (2015) fourth and eight-grade students in the United States scored lower on math assessments in comparison to other educational systems: Singapore, Hong Kong, Korea, and Japan. This study explored the perceived impact of interactive digital media on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized math and computation test scores. Results of this research revealed that interactive media use in the math classroom had a low positive impact on Iowa Test of Basic Skills™ (Riverside Publishing, 2008) standardized computation test scores. This results of the qualitative strand of this study revealed that interactive media use in the math classroom positively impacted student learning and teaching methods. Results of this research also disclosed Internet issues, computer availability, lack of data to inform instruction, and the need for professional development. The researcher proposed 4 solutions to further impact student learning and teaching methods when interactive media is used in the math classroom. Implementation would occur in stages and require at least one year or more to implement, and would be best implemented in stages. Walvoord's (2010) Three Steps of Assessment may be applied to examine the effectiveness of Internet issues and computer availability and Kirkpatricks's (2006) Four Level Training Evaluation Model may be applied to evaluate the effectiveness of professional development training programs. An evaluation cycle should be implemented for continuous improvement of interactive media in the math classroom. This research is useful for educational leaders, faculty, parents, and other stakeholders to determine the effectiveness of interactive media use in the math classroom. Educational stakeholders could utilize the data and solutions from this research to make future decisions about interactive media use in the classroom. Further mixed methods research to explore stakeholder perceptions about interactive media use in the math classroom and longitudinal studies to examine student assessment performance should be considered to further explore how interactive media impacts the math classroom and to further build upon this research.

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Appendix A

Bill of Rights for Research Participants

As a participant in a research study, you have the right:

1. To have enough time to decide whether or not to be in the research study, and to make that decision without any pressure from the people who are conducting the research.
2. To refuse to be in the study at all, or to stop participating at any time after you begin the study.
3. To be told what the study is trying to find out, what will happen to you, and what you will be asked to do if you are in the study.
4. To be told about the reasonably foreseeable risks of being in the study.
5. To be told about the possible benefits of being in the study.
6. To be told whether there are any costs associated with being in the study and whether you will be compensated for participating in the study.
7. To be told who will have access to information collected about you and how your confidentiality will be protected.
8. To be told whom to contact with questions about the research, about research-related injury, and about your rights as a research subject.
9. If the study involves treatment or therapy:
    a. To be told about the other non-research treatment choices you have.
    b. To be told where treatment is available should you have a research-related injury, and who will pay for research-related treatment.