IMPACT OF SUMMER RECESS ON MATHEMATICS LEARNING RETENTION

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This dissertation is dedicated to my dynamic family. I will be forever grateful for your ongoing support. Max and Olivia, I hope you have witnessed your father gracefully navigate my doctoral program. Although, I may have missed an activity now and then, it is my hope that this investment will have a positive impact on you. I hope I have modeled that to accomplish a goal gratification must often be delayed. Keep your eye on your academic goals and avoid procrastinating and eat that frog as soon as you can each day!

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ABSTRACT

IMPACT OF SUMMER RECESS ON MATHEMATIC LEARNING RETENTION

by David G. Hornak

School administrators across the nation are actively searching for solutions to increase student achievement due in part to the significant amount of knowledge that is lost annually each summer. Mathematical computation skills are especially at-risk.

This quantitative research study was designed to investigate the impact of summer recess also known as summer vacation on mathematical computation skills. Assessing children in second and third grade from two different school calendars accomplished this on two separate occasions. First, children from a traditional calendar school and a balanced calendar school were assessed the last week of school respectively using a standardized benchmark assessment called the M-COMP. The same children were then post-tested using the same test following the summer recess. For the traditional calendar children the length of time between each assessment was 12-weeks. Participants from the balanced school calendar were post-tested following a six-week summer recess.

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

A paired-samples t-test was used to determine the significance of the mean values while comparing the results from each school. In addition, a multiple regression was conducted to determine if there was a significant relationship between independent variables: economic status, gender, type of school attended, and whether or not a student received math enrichment or remediation and the dependent variable, post-test results.

The results of the statistical analyses indicated that the type of school a student attends makes a difference on the retention of mathematical computation skills. In addition, children who received either remediation or enrichment retained more of these skills. There were no significant findings in regards to the economic status or gender of a student.

Students who attend a balanced school calendar retain more mathematical computational skills than their counterparts on the traditional school calendar. Students who received either math enrichment or remediation tended to retain more skills than their counterparts who did not remain connected to the curriculum. There was not significance for students considered at-risk due to economic status and gender did not play a role in mathematical retention.

As a result of this empirical study, students who attend the balanced school calendar retain more mathematical computation skills than their counterparts on the traditional school calendar. Administrators seeking ways to increase student achievement in mathematics may consider moving to the balanced school calendar.

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DEFINITION OF TERMS

Achievement Motivation: People are motivated by their need to achieve a standard of excellence (Moore, Grabsch, & Rotter, 2010). The need to achieve is the unconscious drive for excellence in accomplishing a task (Lussier & Achua, 2007).

At-risk children: Children who have been identified as students that qualify for free and reduced breakfast and lunch based on the income eligibility guidelines. At-risk children in this study are considered economically disadvantaged (Federal Register, 2013).

Balanced School Calendar: "The year-round calendar is organized into instructional periods and vacation weeks that are more evenly balanced across 12-months than the traditional school calendar. The balanced calendar minimizes the learning loss that occurs during a typical three-month summer vacation" (NAYRE, 2009, para 2).

Cognitive Psychology: Cognitive psychology is the study of how people learn, think about and retain information (Sternberg, 2009).

Effect Size: Effect size is a method for comparing results on different measures. This independent scale is valued because it allows for relative comparisons about various influences on student achievement (Hattie, 2012).

Executive Attention: Executive attention is the common elements of the working memory and attention combining to predict complex cognitive tasks (McCabe, Roediger, McDaniel, Balota, & Hambrick (2010). "Executive attention is then deemed important to the development of two broad aspects of mathematical performance" conceptual and procedural (LeFevre, Berrigan, Vendetti, Kamawar, Bisanz, Skwarchuk, & Smith-Chant, 2013, p. 255).

Faucet Theory: Faucet theory developed by Entwisle, Alexander, and Olson (1997) is the belief that during the academic school year, the faucet of resources flows for all children; during the summer intermission the faucet of resources is turned off (Rozelle & Mackenzie, 2011).

Influential Theory: Influential theory as described by Abraham Maslow suggests that children's ability to be motivated requires the satisfaction of basic needs such as safety, shelter, and food (Noltemeyer, Bush, Patton, & Bergen, 2012).

Intersession: Intersession is the enrichment or remediation program that takes place during the scheduled one to two weeks breaks each year. Schools can often add up to 30 days to the school year by offering intersession (Ruggiero, 2008).

M-COMP: M-COMP is a Pearson AIMSweb benchmark computation assessment. In school districts that use AIMSweb, children are benchmark tested three times each year (Pearson, n.d.).

MEAP: The Michigan Education Assessment Program test is a standardized assessment used by the state of Michigan to help provide school districts evidence that children are learning at an acceptable rate (MDE, 2014b).

Multi-Track, Balanced Calendar: A multi-track balanced calendar restructures learning across the entire year and allows for multiple cohorts of children to attend the same school at different times in the day or different times of the year. This model is often considered when capacity is an issue or school districts are renovating existing buildings (Pepper, 2009).

Self-determination Theory: Self-determination theory proposes that all humans have a need for competence and are driven to become proficient at a set of skills (Schuler, Sheldon & Frohlich, 2010).

Self-efficacy: Self-efficacy is the confidence or belief that we have in our own abilities that we can make something happen (Hattie, 2012).

Single-Track, Balanced Calendar: As defined by the National Association of Year Round Education, single-track balanced calendar schools "provide a balance…for a more continuous period of instruction. Students and all school personnel follow the same instructional and vacation schedule. The long summer vacation is shortened with additional vacation days distributed throughout the year" (NAYRE, 2009, para 3).

Summer Learning Loss: Summer learning loss amounts to the amount of educational ground children lose during a summer recess from school (Gordon, 2011).

Summer Recess: Summer recess is the time a student is not in school during the summer months. This break is typically up to 12-weeks annually in the United States (Hattie, 2009).

Traditional School Calendar: A school calendar that is in operation from fall to spring annually, roughly up to 180 days (MDE, 2014a).

Year-Round Education (YRE): Year-round education is a cycle of school days distributed across 12-months of the calendar year (NAYRE, 2009).

CHAPTER I

INTRODUCTION

Administrators across the nation and the world are actively seeking solutions to increase student achievement due in part to the amount of knowledge that is lost annually each summer. Ferguson (1999) stated that students appear to lose up to one month of grade-level equivalent skills over the summer. Summer equals a three-month loss annually, according to Hayes and Grether (1983). They further claimed that when the resources are not available, all children tend to regress. Over the course of grades one through six, this loss adds up to 1.5 years of learning loss (Hayes & Grether, 1983). As a result, school officials are left with the unwelcome burden of investigating ways to minimize the summer learning loss that occurs annually. To combat the academic losses, the top five performing countries that took the 4th grade Trends in International Mathematics and Science Study (TIMSS) assessment in 2011, all educate their children on a modified balanced school calendar. The TIMSS report is a comparative study of student achievement in both math and science (Provasnik, 2012). Appendix A explains the type of calendar, the number of school days the top performing countries are instructing students and the type of calendar used to schedule instruction.

One of the strategies being considered by school administrators in the United States is an alternative school calendar. Current information on an alternative school calendar is somewhat inconclusive, can be considered biased, and in some cases conflicted (Glines, 1995).

Restructuring the school calendar has been investigated as a possible way to increase student achievement and minimize the summer learning loss that occurs each year. Proponents argue that the premise is simple and that by reducing the length of summer recess, students will retain more information (Cooper, 2003). Minimizing the amount of learning that is lost as a result of summer recess is the goal of school administrators across the nation (Davies & Kerry, 1999). School administrators along with the public need current research to consider the potential advantages an alternative calendar has in minimizing the impact of summer recess. Restructuring the school calendar is currently being investigated to reduce the amount of knowledge that is lost annually during summer recess. For years, school leaders across America have faced the dilemma of raising academic standards or risk falling behind the rest of the world academically and economically (Maher, 2001). As a result, one method being considered to improve student achievement is a year-round schedule similar to what is used by the top performing countries on the TIMSS report (Provasnik, 2012).

Background

Society benefits from an educated citizenry in a variety of ways. "We know that for today's children, knowledge and academic skills will be critical to their future success and happiness" (Hess, 2006, p. 3). School leaders across America are actively seeking solutions to decrease summer learning loss by allowing for more time on task. Reducing the time required annually to review and re-teach the curriculum from the previous year will result in more opportunities for children to engage with appropriate curriculum (Miller, 2007).

Increasingly, school administrators have studied ways to minimize summer learning loss (Miller, 2007). One method being considered to help increase the retention of knowledge over the summer is to consider operating school on an alternative school calendar. Although alternative school calendars are rarely standard from school district to school district, a shortened summer intermission is common (Ballinger, 1995). The typical traditional summer recess can be as long as 12 weeks. On an alternate school calendar, students are on summer recess no more than six weeks (NAYRE, 2009). The argument to reduce the length of summer recess is driven by the need to minimize summer learning loss (Miller, 2007). Less time off each summer increases the retention of knowledge (Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996). This study will examine the impact of the length of summer recess on mathematical learning retention for second and third grade students.

Over 50 million children take part in summer recess annually and many will discover new interests at a summer camp or traveling with family (Hess, 2006). An issue that needs to be addressed is that millions of other children are at home often without a parent, spending time doing unproductive things (Hess, 2006). Summer recess once made sense. Summer recess was originally created for children to be released from school to help on the family farm (Bainbridge, 2005). The agrarian calendar now serves as a barrier to student achievement (Bainbridge, 2005). With a thriving economy where nearly everyone could find a good paying job, academic achievement mattered less (Hess, 2006). Alternatively, today's school administrators are seeking ways to increase academic achievement.

The traditional calendar can have an even greater impact on the poorest American student (Elliott, 2002). In communities throughout the United States, being in school is often safer than being at home or in the community (Hess, 2006). It is the at-risk child who works to find food, shelter, and clothing daily (Elliott, 2002). Schools that operate on an alternate school calendar can often provide the necessary food and clothing frequently desired over a longer period of time (Elliott, 2002).

Educational reformers advocated for standards-based instructional practices based in large part on the findings of the *A Nation at Risk* report (Goertz, 2007). At a national level the government entered into the standards-based movement with the reauthorization of the

Elementary and Secondary Education Act (ESEA) in 1994. The goal of transitioning to a standard set of outcomes was to minimize the variance of each task (Rubin & Kazanjian, 2011). Standardizing educational outcomes guarantees that children will receive the necessary instruction needed annually. Prior to the standards-based movement, teachers were often left to offer instruction on what they wanted to teach or what they were proficient at teaching (Steiner, 2000).

Standardizing curriculum was derived from the science field (Rubin & Kazanjian, 2011). Applied to education, standardization maximizes the chances that each child in school will be taught a set of agreed upon outcomes (Gilson, Mathieu, Shalley, & Ruddy, 2005). At the close of the 20th century, federal legislators mandated that the standards-based movement be tied to achievement and accountability (Goertz, 2007). Recent reforms guided by *No Child Left Behind Act of 2001* (NCLB), have stimulated the standards movement. In 2009, with many of the same goals as NCLB, President Obama launched the *Race to the Top* (RttT) initiative, which amounted to a competitive grant process for *American Recovery and Reinvestment Act* (ARRA) funds (U. S. Department of Education, 2010). Schools were required to continue NCLB reforms in order to maintain base funding; however, they could apply to receive additional funding through RttT. Although the two programs work in tandem, school districts that applied for RttT funds agreed to the requirement of adopting the *Common Core State Standards* (CCSS) (Paine & Schleicher, 2011). In order to move forward with reforms to improve academic achievement, states requested a flexibility waiver from the U.S. Department of Education for flexibility of ten provisions of the Elementary and Secondary Education Act (ESEA) of 1965 (ESEA Flexibility, 2012). States that have amended their RttT plan and or budget are now being governed by the ESEA flexibility waiver (ESEA Flexibility, 2012). While standards were established to minimize the variance between teachers, classroom, and school districts, the majority of schools are still operating on the traditional school calendar (NAYRE, 2009). The intent of the standards-based movement is to insure that all children receive similar instruction.

Schoolteachers and administrators have the power to transform education (Rury, 2013). According to Rury, “Schools are the most familiar social institutions that people encounter in today’s complex modern society” (p. 13). For the most part, educational experiences have been consistent for Americans over time (NAYRE, 2009). Depending on the era, schools were established to meet the goals dictated by sponsoring institutions, such as local governments or churches (Rury, 2013). Regardless of the sponsoring institution, there was a common commitment by all schools to impact individual growth and human development. As a result, standards have changed over time while many of the structures have remained constant (Rury, 2013). Considering the past, schools have attempted to impact society since the 17^{th} century (Rury, 2013).

The need to change the structure of the school calendar is often met with resistance, due to the common experience the majority of Americans experienced while attending school (Rury, 2013). “The six-hour, 180-day school year should be relegated to museums, an exhibit from our education past. Our usage of time virtually assures the failure of many students” (NEC, 1, 2005, p. 1). The traditional school calendar became the norm for schools in the 19^{th} century and has remained the dominant calendar used in schools across America since (Rury, 2013). Due to the fact that the majority of Americans were educated on traditional calendar schools and the bulk of schools continue to operate on calendars established in the 17^{th} century, the learning gaps established by the long summer recess are a target for teachers as students prepare to be college and career ready by graduation as mandated by current standards-based movements (U. S.

Department of Education, 2010). The current calendar upon which the majority of schools operate has never produced evidence that it fosters quality learning (Pepper, 2009). "In fact, studies have shown that the long summer break causes significant learning loss, resulting in the need for extensive review at the beginning of each new school year" (Pepper, 2009, p 118).

Educational reform movements are not new. In 1895, Oscar Wilde noted that the traditional system of educating children was unsound (Glines, 2009). The same system for the most part is still in operation today. Educating children from Labor Day to Memorial Day continues to be the dominant calendar used by school districts nationwide (Glines, 2009).

Administrators are currently dealing with high-stakes testing, new core standards, increased levels of accountability, and yearly evaluations for every faculty member. According to Usher (2012), by the end of 2011, 49% of the schools in the United States were failing to meet the threshold set forth by NCLB, thus failing to meet minimum standards according to *adequate yearly progress* (AYP) mandates. Driving my study is the question being asked by educational stakeholders, whether an alternative school calendar has a positive impact on academic retention of mathematic computation skills, thus mitigating summer learning loss.

The association between an alternative calendar and the support nationally is perplexing to proponents. In 2007, the *National Association of Year Round Education* (NAYRE) went on hiatus and remains dormant (NAYRE, 2009). Although researchers continue to study the impact of year-round education, the future of the organization remains in question. In a 2014 state of the state address, a Midwestern governor recommended that educators throughout the state consider the impact of the balanced school calendar. Subsequently legislators appropriated millions of dollars for school districts to access when making the transition from the traditional calendar to the balanced school calendar (Snyder, 2014). School districts have an opportunity to apply for the appropriated funds with most wishing to use the funds to upgrade their facilities. Awarded school districts must agree to transition to the balanced school calendar for a minimum of three consecutive years (MASA, 2014). The Midwestern governor recently signed House Bill 4295 into law as Public Act 116 of 2014 (MASA, 2014). This bill required adjustments to the 2013-14 School Aid Budget. The law included $2 million for schools to pilot year-round programs. For districts to access these funds a certain percentage of pupils in the district had to qualify for free and reduced lunch and the application had to be approved by the supporting school board (MASA, 2014). A school district can qualify for up to $750,000 to be used for building modifications and must continue to operate on the balanced school calendar for at least three years (MASA, 2014).

Although the traditional school calendar remains the dominant calendar used by school districts nationwide, the idea of balancing or extending the school calendar dates back to the 1840s when schools in big eastern cities were open 240-250 school days each year (Glines, 2009; Silva, 2007). It was in the 20-year period between 1870 and 1890, when many communities reduced the school year to 180 school days and started the concept of vacation during the summer (Glines, 2009; Silva, 2007). During this time, summers were used for additional school opportunities by outside groups to teach English for the most part to immigrant families (Glines, 2009; Silva, 2007).

American children attend school the fewest number of days in a school year compared to students in the 12 wealthiest countries across the world (Bainbridge, 2005) (Appendix C). By attending school less than half of the calendar year, children in America only receive a portion of the core instruction their counterparts receive across the world, thus resulting in lower overall academic achievement (Bainbridge, 2005). Despite annual changes in academic standards and accountability, students in the United States attend school the same number of days as their counterparts in the early 1900s. Each year, standards change and the accountability increases, however, typically the school year remains the same (NAYRE, 2009).

The three-month break was originally established for children to be released from school during the summer months to help on the family farm (Bainbridge, 2005). The agrarian calendar that continues to be the dominant calendar used by school districts in America may actually be a barrier to increased achievement (Bainbridge, 2005; Ballinger & Kneese, 2009).

Manufacturing jobs once available for nearly everyone are no longer accessible (Rotman, 2013). Currently school systems are attempting to prepare children to compete on a global market for lucrative brain-based positions (Hess, 2006). Educators today are preparing children for jobs that have yet to be created (Dwyer, 2011). As a result, the gap created by the long summer recess requires teachers to maximize student contact time. The question educators continue to discuss is why they continue to educate children on the traditional school calendar, which requires up to eight weeks of remediation at the beginning of each school year to re-teach information that was lost over the summer (Cooper, 2003; Davies & Kerry, 1999).

Summer recess has the biggest impact on at-risk children and it is time to acknowledge that extended time off each summer may be a poor fit for current American families (Hess, 2006). American families once cherished the long summer recess for the support that it provided around the home and farm are now looking at the current system and beginning to question the long summer recess (Hess, 2006).

The days of a three-month summer recess became outdated over a century ago (Elliott, 2002). Due to the longstanding tradition, political, social, and cultural realities, changing to an alternative calendar continues to receive a great deal of resistance (Shields & Oberg, 2009).

Balanced Calendar

Although a balanced school calendar is commonly referenced as a year-round school calendar, for the purposes of this study, balanced school calendar will be used. The term *summer learning loss* refers to the amount of academic information that students lose during the extended summer recess period. Because of this deficit, educators are required to re-teach previously acquired skills the following school year (Cooper et al., 1996). By reconfiguring the school calendar, educators can more efficiently use time to educate children (Ruggiero, 2008).

Balanced calendar schools have existed in some form since the 1600s; however, the modern balanced school calendar can be linked to 1904 (Fischel, Hale, & Hale, 2003). Although in existence since the early 1900s, the balanced calendar took 90 years before the first school opened in this Midwestern state (Heinze, personal communication, 2007). Balanced calendar schools gained popularity in the 1980s and began to prosper following the *National Education Commission* (NEC, 2005) report on time and learning called *Prisoners of Time*:

> Learning in America is a prisoner of time. For the past 150 years, American public schools have held time constant and let learning vary. The rule, only rarely voiced, is simple: learn what you can in the time we make available. It should surprise no one that some bright, hard-working students do reasonably well. Everyone else, from typical students to the dropout, runs into trouble. (p.1)

Those affiliated with schools are held captive to the structures established in the past, dealing with poverty, inequality of schools, and economic diversity since the 17th century (Rury, 2013). Schools accepting the status quo will continue to achieve similar results. Without expanding and evolving over time, our educational systems will continue to struggle to successfully prepare children to become college and career ready as mandated by current reform initiatives. American children are struggling to meet the expectations set forth annually (Ballinger & Kneese, 2006).

The amount of knowledge that is lost during a summer break by children is paramount (Cooper, Charlton, Valentine, & Muhlenbruck, 2000). The extent of the summer learning loss becomes more dramatic as students get older (Cooper, 2003). Smith (2012) indicated that two-thirds of the achievement gap in ninth grade could be attributed to the amount of required time teachers need to take to re-teach each fall. By the time a student enters ninth grade, it is feasible that he or she may have lost up to a year of instruction due to the need to re-teach the curriculum each autumn, thus creating a learning gap among students based on the academic calendar (Cooper et al., 1996). All children attending school on the traditional calendar, according to Cooper et al. lose an average of 2.6 months of math skills during the summer recess.

The alternative calendar enhances learning by decreasing the long summer break and adding more frequents break throughout the year (Ballinger & Kneese, 2006). Student learning need not be directed by the seasons and according to Ballinger and Kneese, many educators who teach in schools with modified alternative calendars noted that students are less likely to forget the knowledge they acquired due to fewer interruptions in instruction. Supporters of the balanced school calendar believe that attending school throughout the year reduces the need to re-teach when returning to school after a summer break (Ballinger 1995; Fairchild & Boulay, 2002; Miller, 2007). "Research demonstrates that all students experience significant learning losses in procedural and factual knowledge during the summer months" (Fairchild & Boulay, 2002, p. 2). There is a difference between the way students learn and retain information (Ballinger & Kneese, 2006). Ballinger and Kneese further stated that if students learn throughout the year, school should be in session throughout the entire year.

Due to the impact of the summer learning loss, proponents of the balanced school calendar promote extending the academic year across the calendar year (Ballinger, 1995). A long summer recess tends to negatively impact the retention of knowledge. Learning is unbalanced in a traditional school calendar model (Cooper, 2003; Kneese, 2000). Schools are attempting to use time more efficiently (Ballinger & Kneese, 2006). If school administrators were to publish the fact students are in school less than half of the days in the school year, most members of the public would begin to question the current traditional school model (Ballinger & Kneese, 2006). Ballinger and Kneese further claimed that significant learning loss occurs year after year because of the long summer recess, and re-teaching becomes a requirement each fall.

Cooper (2003) explained that teachers are required to rush the delivery of the curriculum across nine months. In addition, traditional calendar teachers spend up to eight weeks annually following summer recess, re-teaching the previous year's curriculum (Cooper, 2003; Davies & Kerry, 1999). Kneese (2000) opined that by reducing the length of the summer recess, children tended to retain more of the information learned the previous school year.

Without three months away from academic routines, it is assumed that fewer children will develop devastating habits, join gangs, or require months of remediation during the fall (Elliott, 2002). Supporters of the balanced school calendar indicated that the socioeconomically disadvantaged student benefits significantly from a reduced summer recess (Shields & Oberg, 2009). Shields and Oberg stated that by educating children throughout the year, schools not only see the benefits of a modified calendar for at-risk children, but for all children.

Cooper (2003) stated that one consistent conclusion from the meta-analysis on the summer recess was that summer learning loss impacts students differently. The most significant finding was that the impact of the summer recess on mathematics is greater than the learning loss on reading (Cooper, 2003; Miller, 2007). Based on Cooper's finding, this study will focus on the impact of the summer learning loss on mathematics in a Midwestern school district.

Statement of the Problem

The way the majority of American children are being educated must change if students are going to compete on a global level (Davis, 2006). It is mind-boggling to expect children to acquire the knowledge and skills to compete on a global level while attending school only 49% of the year (Davis, 2006). Davis continued with the impact to economically disadvantaged children is even more dramatic and the gap between the middle class and the lower class continues to grow due in part to the schedules school districts promote annually. Balanced school calendar supporters claim that students being taught on the balanced calendar do better academically than students who receive instruction on the traditional calendar (Haeberlin, 2002). By breaking up the school year into manageable learning chunks, students and staff find opportunities for renewal and tend to remain more focused in the classroom (Haser & Nasser, 2005). School districts need to work to find balance in academic calendars. Without balance, mathematics computation skills and achievement levels are at the greatest risk when children attend school on the traditional calendar (Kneese & Knight, 1995).

For the past 40 years, educators have been debating academic calendars. Cooper (2003) stated that the summer learning loss negatively impacts the retention of knowledge. By transitioning to the balanced school calendar, school administrators desire a positive effect on the summer learning loss. Research is needed to further explore the phenomenon between the relationship between the school calendar and the summer learning loss due in part to the increased levels of accountability, the need to better understand the impact summer recess has on the learner, and the gap in the literature.

Children on the balanced school calendar attend school the same number of days (approximately 180) as traditional calendar school children, but the breaks are spread throughout the academic year and the summer recess is limited to six-weeks. With a shorter summer, there is less re-teaching in the fall (Ballinger, 1995). During each break, faculty have the opportunity to reflect on what has been taught and plan for the future (Haser & Nasser, 2005). The time between these breaks is rarely longer than 45 consecutive school days (Ballinger, 1995).

Finally, supporters of balanced school calendars promote a change from the traditional calendar by reducing the long summer recess and creating additional breaks throughout the school year (Ballinger, Kirschenbaum, & Poimbeauf, 1987). Proponents of both forms of calendar reform raise concerns about the negative impact that summer recess has on learning (Cooper et al., 1996). Cooper et al. contended that children learn best when instruction is continuous and a 12-week summer recess is too long. Although the balanced calendar is linked to modest achievement gains, little focus addresses understanding the relationship between the academic calendar and the summer learning loss. As a result, the current literature is dated and in many cases fails to support the benefits of the balanced school calendar. Questions regarding the impact of the balanced school calendar led to this study. In particular, I will examine the relationship between the school calendar and the summer learning loss.

In previous research that has been conducted regarding the balanced school calendar and its effects on the summer learning loss, results have been somewhat inconclusive and dated (Hattie, 2009; Miller, 2007). In their meta-analysis, Kneese and Knight (1995) found that balanced school calendars had significant positive effects on student performance. The age of this meta-analysis requires follow-up research be conducted to confirm the positive effects the balanced school calendar has on children. The results of the Kneese and Knight study are intended to provide the needed research and support for policymakers and school officials interested in moving a traditional school calendar to a balanced school calendar. Children, who are not exposed to continuous learning opportunities throughout the year and especially in the summer, tend to lose ground academically (Lundstrom, 2005).

The summer learning loss may have an even greater effect on lower income children who may already be struggling (Lundstrom, 2005). If this pattern continues, in a few short years, a child could be several years behind, accounting for 80-100% of the gap between low income children and children from the middle class (Lundstrom, 2005). The impact on math is typically significant (Schulte, 2009). Lundstrom (2005) stated that 61% of low-income families do not have any books at home and schools are some of the only resources available to many children. Haeberlin (2002) acknowledged that most children do not retain their academic knowledge over a 12-week summer break from school. Ballinger (1995) stated the primary reason to change to the balanced school calendar from a traditional school calendar is to eliminate the significant learning loss that happens over summer break. Disadvantaged students, according to Morse (1992), forget more during summer break than any other child. Moving to a balanced school calendar will increase the performance of students who may not have the resources readily available and may not be supported at home (Haeberlin, 2002). If the average child either maintains an academic level or in fact has the opportunities to gain exposure to math concepts, the gap between an average, middle class child and a low-income child can become tremendous. Traditional calendar schools tend to put disadvantaged children at a greater disadvantage by holding true to a long summer intermission between school years (Haeberlin, 2002). School officials need to be aware of the unintended consequence of continuing to operate on an outdated school calendar.

With the fact that summer recess is most detrimental on math, Kneese and Knight (1995) reported that balanced calendar schools have a significant advantage over their counterparts on the traditional calendar when facing the summer learning loss. By shortening the 12-week summer break; schools can minimize the regression caused by the summer recess (Haeberlin, 2002).

In second and third grade, teachers are moving away from a concrete level of completing equations in favor of helping students develop quick recall of addition and related subtraction facts (Johnson, 2000). Teachers work to help children understand numbers and operations along with the ability to manage and solve problems (Varol & Farran, 2007). Automaticity can have a positive impact on mathematic computation skills (Sternberg, 2009). Automaticity develops when low-level skills such as counting become automatic (Tronsky, 2005). This tends to develop during early elementary years (Tronsky, 2005).

Achievement gaps exist between schools across America. Without structural changes, many schools will continue to lag behind state averages on standardized assessment tests. There is a need to do more research on the impact of balanced calendar schools and the summer learning loss. Additionally, there is a need to understand if differences exist from traditional calendar schools in achievement levels in mathematics.

The body of literature addressing student achievement is expansive. Abraham Maslow (1954) suggested that children can be motivated by academic achievement only after the basic needs are met (Noltemeyer, Bush, Patton, & Bergen (2012). The relationship between unmet needs and student achievement are tied together with Maslow's influential theory. Many children that are attending school across the United States have experienced a deficiency of one or more of Maslow's basic needs (Noltemeyer et al., 2012). Maslow postulated that only when the basic needs are met, could a child fully progress toward proficient levels of achievement (Noltemeyer et al., 2012).

Self-determination theory proposes that all humans have a need to become competent at a set of skills (Schuler, Sheldon, & Fronhlich, 2010). The self-determination theory as related to student achievement, serves as the motivation or desire to become better at a set of skills. Children are driven to become competent at a set of skills after their basic needs are met and they become motivated to strive for academic proficiency (Schuler et al., 2010).

Achievement motivation is also known as the need for achievement (McClelland, 1961). The concept of achievement motivation ties together several theories such as the influential theory and the self-determination theory by integrating each theory thus creating a sense of urgency for a student to become proficient on a set of academic standards. McClelland (1961) stated that motivation to achieve is initiated when an individual knows that they are responsible for outcomes. The achievement motivation theory links many achievement related theories together, it helps educators, economists, and historians make sense of why children work to avoid failure (McClelland, 1961). The strength of the achievement motivation theory is that it serves as a motivation to children as they embark on academic tasks (McClelland, 1961). The revolution of the standards-based era serves as a motivator for children to strive to become proficient at a set of skills.

Without consistent practice, cognitive psychology suggests, facts and computation skills are most at risk of being lost (Cooper et al., 2000). Cognitive psychology is the study of how people learn, think about, and retain information (Sternberg, 2009).

Complicating the way children learn, retain, and gain strategies to complete a mathematical problem are emotional factors and attitudes. Mathematical achievement can be linked to mathematics anxiety (Dowker, Bennett, & Smith, 2012). Children that have high levels of math anxiety tend to find ways to avoid doing math (Ashcraft, 2002). Mathematics anxiety may also influence the performance by overloading the working memory (Ashcraft & Krause, 2007). To help better understand the sample, a short survey was provided during the post test and participants selected whether or not they liked math.

Purpose and Focus

The purpose of this empirical study is to investigate the relationship between the length of summer recess and mathematical learning retention. The focus is to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

The effects of summer learning loss have been studied. The earliest known study of summer learning loss occurred in 1906 when a mathematics professor at the State Normal School in New Paltz, New York tested seven pupils in June and again in September (Cooper et al., 1996). The results demonstrated summer learning loss; however, no statistical tests were conducted (Cooper et al., 1996). Similar studies were conducted in following the initial 1906 pre-test, post-test comparison study with the latest pre-test, post-test mathematic computation study being conducted in 1969 (Cooper et al., 1996). The recent literature on the relationship between the school calendar and the summer learning loss is limited and needs further study, due in part to the age and results of the previous studies (Miller, 2007). Though the balanced school calendar and the summer learning loss have been tied together in previous research studies, the impact the balanced school calendar has on the math computation skills in relation to the summer learning loss, has yet to be investigated in this format in the past 45 years.

Research Questions

Seeking to better understand the relationship between the balanced school calendar and the summer learning loss, the following research questions drive the study after controlling for causal variables such as, but not limited to: state achievement scores, economic status, disabilities, gender, attendance rates, and ethnicity. 1) To what extent does the length of summer recess impact student mathematical learning retention? 2) Is there a relationship between student mathematical learning retention and economic status of students, gender, intersession attendance, and academic calendar?

Theoretical Framework

Proponents of the balanced school calendar use Faucet Theory to support their position (Entwisle, Alexander, & Olson, 2001). Faucet theory developed by Entwisle, Alexander, and Olson (1997) is the belief that during the academic school year, the faucet of resources flows for all children; during the summer intermission the faucet of resources is turned off (Rozelle & Mackenzie, 2011). Typically, the faucet theory is represented as an opportunity to access resources needed for a student to learn. Faucet theory, as it relates to education, rests upon two dominant assumptions: 1) When children are in session, all children can access the curriculum and learn, however, during summer recess, the learning resources are turned off, and 2) The amount of resources available to a middle class child compared to an at-risk child may contribute to further summer learning loss (Borman, Benson, & Overman, 2005; Gershenson, 2013; Miller 2007; Rozelle & Mackenzie, 2011; Zvoch & Stevens, 2013). The underlying components of this theory suggest that school administrators aim to maintain or minimize summer learning loss annually (Mccombs, Augustine, Schwartz, Bodilly, Mcinnis, Lichter, & Cross, 2011). Rozelle and Mackenzie (2011) explained that administrators are capable of expanding the supply of program offerings by transitioning to the balanced school calendar to maximize the time that resources are available, specifically addressing the length of summer recess. This investment, according to Entwisle et al. (2001) should result in significant increases in learning retention mitigating the summer learning loss. Children attending the balanced calendar school retain more knowledge during the summer months due to the shortened length of the recess (Cooper et al., 1996).

The faucet theory makes sense of seasonal patterns in children's academic development (Borman et al., 2005; Mitchell & Begeny, 2014). The loss suffered over the summer compounds annually and potentially reaches a loss of 1.5 years of achievement by sixth grade (Cooper et al., 1996; Entwisle et al., 2001). When school is in session, all students learn at about the same rate; however, during the summer when the resources and instruction are turned off, the gap widens between the middle class student and the at-risk student (Entwisle et al., 2001; Gershenson, 2013; Rozelle & Mackenzie, 2011). Furthermore, a substantial body of research argues that the majority of the achievement gap between middle class and their at-risk peers can be attributed to how prepared children enter kindergarten and how detrimental the summer recess is on student achievement (Borman et al., 2005; Rozelle & Mackenzie, 2011).

The seasonal pattern associated with the faucet theory typically fails to emerge due to the typical school assessment schedules (Entwisle et al., 2001). In most cases, schools proctor standardized tests one time per year and a fall-to-fall or a spring-to-spring comparison typically gives the impression that middle class children learn more over the entire year than their at-risk counterparts (Entwisle et al., 2001). The seasonal data in several metropolitan areas such as Baltimore and Atlanta demonstrates all children lose knowledge over the summer and at-risk children suffer further learning losses due to the summer recess (Entwisle et al., 2001).

The faucet theory acknowledges that all children when in school learn at a similar rate (Entwisle et al., 2001; Rozelle & Mackenzie, 2011). A typical 12-week summer produces a loss of 2.6 months of previous learning in mathematics (Entwisle et al., 2001). Without investigating alternatives to minimize the loss that occurs during the summer recess, teachers and administrators will continue to be required to close the gaps created each summer. The balanced school calendar may be the answer to minimizing the loss that occurs during summer recess (Gershenson, 2013).

Assumptions

The objective of this study is to examine the relationship between the balanced calendar and the summer learning loss experienced by second and third grade students in mathematics. It is assumed that the tests will provide a true and accurate measurement of student achievement at specific points in time. Another assumption considered is that students will not be receiving mathematics instruction during the summer months. A brief survey will be offered prior to the post-test to better understand whether or not children participated in an enrichment or remediation program associated with math instruction.

Significance

Various groups will benefit from the results of this study. The intended purpose of this quantitative study will be to provide policy makers, school board members, school administrators, teachers, and community members with data about the relationship between the length of summer recess and student mathematics achievement.

The findings of this study may also be useful to colleges and universities for curricular development in administrator preparation programs. The results of this study may also produce recommendations, future research, and change in current practice for building administrators.

Summary

Summer learning loss accumulates year after year (Ballinger & Kneese, 2006). An effort to improve school systems and reduce the loss that occurs annually, according to Ballinger and Kneese, is an ongoing process. Typical improvement takes time and to some educators, restructuring the school calendar is considered a short-term fix that should produce immediate results (Ballinger & Kneese, 2006). Advocates for the balanced calendar agree that increasing opportunities for learning to occur throughout the calendar year reduces the loss that occurs each summer recess (Ballinger & Kneese, 2006).

Supporting this study is the Faucet Theory. Simply stated, learning occurs for all children during the school year at the same rate (Enwisle et al., 1997; Gershenson, 2013; Mitchell & Begeny, 2014; Rozelle & MacKenzie, 2011; Zvoch & Stevens, 2013). When school is in session, the learning faucet is turned on and during the summer recess; the learning faucet is turned off. Learning outcomes are more likely to vary by content area and poverty level (Zvoch & Stevens, 2013). In particular, losses in mathematics tend to be greater than any other subject and become more pronounced for at-risk children (Enwisle et al., 1997).

The purpose of this empirical study is to investigate the relationship between the length of summer recess and mathematical learning retention. The focus is to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

This pre-test/post-test, quantitative comparison study is considered descriptive quasi-experimental research (Roberts, 2004). This study collected data in two phases. Initially, the data from Pearson, Inc. M-COMP was collected in the final week of the school year from children who attend school on two different school calendars. The same children were post-tested during the first week of school the following August or September using the same assessment, following a short survey (Appendix B).

The selected schools have similar at-risk populations and standardized test results. Both schools were within the same school district, therefore, there was curricular equity. Similar professional development opportunities existed for teachers in each of the selected schools (HPS, personal communication, 23, May, 2014).

Summer learning loss is an issue that requires school districts to consider how to best reduce the loss that occurs annually (Ballinger & Kneese, 2006). Ballinger and Kneese continued stating that summer learning loss accumulates over time and at-risk children tend to be especially vulnerable. Balancing the school calendar may be an option for school districts that are struggling to reduce the achievement gap that occurs between middle class and lower class

CHAPTER II

LITERATURE REVIEW

Introduction

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state. The literature addressing the balanced school calendar and the summer learning loss is plentiful among each separate topic, however dated.

Variations in the school calendar have existed since formal education was developed (Mattingly, 2007). In the 1800s, schools in large communities tended to be in operation for up to 12-months of the year; however, few students attended the whole year (Glines, 1995). In contrast, rural schools in the same period operated only three to six months of the year due to the agricultural lifestyle, weather, and transportation (Glines, 1995). Compulsory education and the current traditional school calendars were created for a manufacturing society on an agrarian calendar (Glines, 1995). These initiatives provided the farming community a workforce to help work on the farm (Glines, 1995). With changes in family status, the need for parents to work required accountability reports such as Education Yes! And No Child Left Behind, as well as new initiatives such as Response to Intervention which require schools to implement multi-tiered systems of support for all children, public opinion is now beginning to support a longer school year (Rakoff, 1999). President Obama, Secretary of Education Arnie Duncan, and previous Michigan governor Jennifer Granholm all agreed that abandonment of the agrarian school calendar was long overdue (Bray & Roellke, 1998). Proponents of the balanced school calendar think American children should be spending more time in school as the United States ranks near the bottom among industrial nations in the number of days children attend school each year (Barrett, 1990; NAYRE, 2009).

The impact of the summer learning loss cannot be measured in speculation about what might be lost, but rather in the research about the topic. Although previous studies have explored the relationship between summer recess and summer learning loss, this study specifically examined the relationship between the length of summer recess and mathematical learning retention.

Purpose and Criteria

This review of the literature was based on the balanced school calendar, traditional school calendars, summer learning loss, summer recess, at-risk students, the faucet theory, and executive attention. Each subject will be described in detail and linked together. When linked together, the balanced school calendar and the faucet theory help to illustrate the impact that summer learning loss has on all students' especially at-risk children (Enwisle et al., 2001).

By adopting the balanced school calendar, districts are hoping that student achievement levels improve. Advocates of the balanced school calendar believe that reorganizing the existing school calendar is the first step in combating the summer learning loss. Supporters of the balanced school calendar contribute the faucet theory as the driver behind this reform movement.

Balanced School Calendars

History

The balanced school calendar is not a new idea. The operation of balanced calendar schools began in 1645 in Dorchester, England (Cammarota, 1961). By 1840 in the United States, several major cities had school systems with schools calendars that extended beyond the traditional calendar. In the 1800s New York City schools attended school for 49 weeks; Chicago 48 weeks; Cleveland 43 weeks; Brooklyn, Baltimore, and Cincinnati attended school for eleven months (Lane, 1932). During this period, Detroit and Philadelphia students attended school over 250 days of the year (Lane, 1932).

Students attended school on the balanced school calendar for a number of reasons in the 1800s. Immigrants wanted their children to attend school for the entire year to help them acquire the English language and become assimilated into the culture as soon as possible (Hermansen & Gove, 1971). Parents of immigrant school children also desired to have their children supervised in schools while they were working in the mills, factories, and professional shops (Hermansen & Gove, 1971). Hermansen and Gove stated that the length of the school year was directly related to the needs of the community. In rural communities, schools were only open three to six months as the majority of the learning was thought to occur helping on the family farm.

In the last half of the 19th century, industrial society and life on the farm were becoming more mechanized and community leaders became more concerned with providing all children regardless of urban or rural setting an equal opportunity to learn (Hermansen & Gove, 1971). During this period, state legislatures began to regulate education in state constitutions. As education became more controlled by each state, legislatures worked to balance urban and rural needs by establishing a minimum standard regarding the number of days and hours a child attended school (Hermansen & Gove, 1971). Gradually, by the beginning of the 20th century, the school day became standardized in law with a minimum of 180 school days per year as established by state law (Hermansen & Gove, 1971).

Modern balanced calendar schools have ties back to 1904 (Fischel, et al., 2003). The National Education Commission gave a significant increase in attention to the alternative calendar idea in the *Prisoner of Time* report in 1994. The 2005 follow-up report describes:

> Learning in America is a prisoner of time. For the past 150 years, American public schools have held time constant and let learning vary. The rule, only rarely voiced is simple: learn what you can in the time we make available. It should surprise no one that some bright, hard-working students do reasonably well. Everyone else—from the typical student to the dropout –runs into trouble. (NEC, 2005, p.1)

The report continued to state:

> Our schools and the people involved with them…students, teachers, administrators, parents, and staffs…are prisoners of time, captives of the school clock and calendar. The six-hour, 180-day school year should be relegated to museums, an exhibit from our educational past. Our usage of time virtually assures the failure of many students. (NEC, 2005, p.1)

The *Prisoners of Time* report was released during a time when school accountability as well as resource reductions increased the interest in an alternative calendar and renewed the concept of year-round schooling. The traditional nine-month calendar became the norm despite social and economic changes in America (Fischel, et al., 2003).

Schools have operated on the alternative calendar for many years. In the 1991-1992 school year, 23 states offered 1,646 schools that operated on the balanced school calendar (Stenvall, 2002). In the 2001-2002 school year, 44 states offered 3,011 balanced calendar schools in 559 school districts nationwide (Stenvall, 2002). The balanced school calendar offers flexibility to operate school throughout the calendar year (Ballinger, 1995).

The traditional calendar was developed to assimilate immigrant children quickly into a local society (Heaberlin, 2002). The economy in America is no longer running on agriculture (Heaberlin, 2002). Schools are currently preparing children in the 21st century for jobs that have yet to be created, therefore there is little explanation offered to continue to educate children on an agrarian calendar for a manufacturing society (Heaberlin, 2002).

Intersession

The balanced school calendar challenges the status quo of the traditional calendar (Hamilton, Johnston, Marshall, & Shields, 2006). On the balanced calendar, children have half of the summer break as their counterparts on the traditional calendar. Due to the frequent breaks, the balanced calendar can serve as an opportunity for children to remediate academic gaps in achievement (Stenvall, 2002) in what is often called an intersession. Intersessions are either remediation or enrichment opportunities that occur during a scheduled break (Hamilton et al., 2006). By offering intersession, balanced calendar schools are able to find opportunities for children that require remediation and enrichment outside of the school calendar. The majority of balanced calendar schools offer up to 30 days of intersession as a result, schools operating on the alternative calendar could offer a school year that is closer to countries across the world that attend school over 200 days per school year (Appendix C). School principals currently operating on the balanced calendar believe that intersessions are one of the most impactful advantages of moving to an alternative calendar (Ruggiero, 2008). Ruggiero continues to write, for many schools, intersessions are a time for teachers to work to improve student achievement. During intersession children often receive help and enrichment depending on the needs of each individual student. As an optional program, intersession serves as an opportunity for at-risk, low-performing children, and non-native English speaking children to receive remediation programming (Ruggiero, 2008). Intersessions operate the same number of hours as a typical school day and often provide breakfast and lunch for the participants (Ruggiero, 2008). Due to the frequent breaks, students and teachers report a greater sense of satisfaction and better attendance (Stenvall, 2002).

Restructuring

Restructuring the school calendar requires research and an open mind. It is recommended by Stenvall (2002) to initiate the conversation with faculty members in the school that is being considered for the change. Often the adult roles and concerns get in the way of what may be a benefit for children. Stenvall stated several reasons adults object to the balanced calendar including personal and family adjustments, a shorter summer, lack of opportunities to work a second job in the summer, reduced opportunities to take summer classes and complaints regarding working conditions such as lack of air conditioning. On a counter note, current balanced calendar school employees can view each of the concerns listed above as an opportunity (Haser & Nasser, 2005).

The balanced school calendar generally demonstrates positive effects of continuous learning and often has positive influences on school climate; morale; attitudes of students, teachers, and parents; as well as the absenteeism of both students and teachers (Heaberlin, 2002). Teachers report that the longer they work on the balanced calendar, the more they prefer it (Naylor, 1996). The balanced calendar promotes teacher job satisfaction and the necessary stability to the classroom that children desire (Haser & Nasser, 2005). In addition, Haser and Nasser (2005) stated that the breaks allow personal and professional renewal for faculty and staff. The difference between an experienced teacher that has time for reflection during a scheduled break and a teacher that is overwhelmed early in the school year due to the stress of the academic calendar is tremendous.

Balanced school calendars gained popularity across the world since the 1980s. Educators report a greater sense of job satisfaction, a sense of continuous renewal, and a positive impact on student achievement as advantages to the balanced school calendar (Haser & Nasser, 2005). The longer an educator works on the balanced school calendar, the more satisfied a teacher becomes with the profession and the longer they remain in the profession (Haser & Nasser, 2005; Naylor, 1996).

As defined by this literature review, students that attend school on the balanced school calendar attend the same classes and receive the same 180-days of instruction, as do their counterparts on the traditional school calendar. The most significant difference is that the balanced school calendar is organized into instructional periods with established vacations that are evenly distributed throughout the entire year (Glines & Bingle, 2002). Although the balanced school calendar may vary from district to district, the unifying characteristic is that all balanced school calendars are organized to shorten the long summer recess (Glines & Bingle, 2002).

Examples of Calendar Reform

School districts that choose to adopt the balanced school calendar typically make the move with a goal to solve a problem (Ballinger & Kneese, 2006). Frequently, school districts adopt the balanced school calendar to reduce the summer learning loss that occurs annually. By reducing the number of days and weeks a teacher is required to re-teach each fall, supporters of the balanced school calendar agree, there tends to be a positive impact on student achievement (Ballinger & Kneese, 2006). When providing opportunities for students to continuously learn, school districts often look to adopt a single-track calendar which all students and teachers follow the same schedule and learning periods (Ballinger & Kneese, 2006).

The most popular single-track balanced calendar schedule in the United States is the 45 days of instruction with a 15-day recess (Ballinger & Kneese, 2006). The modified school calendar has other benefits. Due to the frequent breaks, there tends to be less student and teacher burnout and both students and teachers have higher attendance levels as dentist and medical appointments are often scheduled during a break (Ballinger & Kneese, 2006). Also noted by Ballinger and Kneese is the fact that attendance records tend to be better at schools that have adopted the single-track model. A second model is sometimes considered when a school district is called the multi-track calendar. A multi-track balanced school calendar is sometimes used in schools where capacity is an issue. The multi-track model allows for two separate groups of children to attend the same school, just at different times of the day or different times of the year (Pepper, 2009). The multi-track model is implemented with the same intent as the single-track model, to minimize the impact of annual learning loss during summer recess (Ballinger & Kneese, 2006).

Traditional School Calendar

Currently in the United States, the traditional school calendar is about nine-months long and operates between September and June with a 12-week break for summer recess (Ballinger & Kneese, 2006). The traditional calendar has been referred to as the agrarian calendar (Weiss & Brown, 2005). Weiss and Brown stated that the agrarian calendar is believed to have roots that dates back two centuries when farming and ranching were the dominant way of life in the United States. With the boom of the industrial revolution and current urban technology driven society it is no longer necessary to hold firm to the 12-week summer vacation for children to help on the family farm or ranch. According to Wilmore and Slate (2012), modern machines and farm equipment have reduced the need for a large number of people to complete tiresome tasks of planting and harvesting. Talbot (2000) related:

> It is true that summer vacation is a mere artifact of the days, when farming played a bigger role in our economy, but by now it's a precious artifact with an accretion of sweet associations and sense of possibility all its own. (p. 6)

Summer recess remains intact due in part to the lifestyles that developed over the 20th century by middle and upper class families who desire extended breaks from school for children to spend with their families (Talbot, 2000). Over the past 150 years, economic success has allowed families to budget for family trips during the long summer (Fischel, 2006). Having three months off in the summer is no longer appropriate considering children enter the school year each fall already behind (Cramer, 2006). The typical home in America is no longer equipped to support children over the summer (Cramer, 2006). Hess (2006) stated that the majority of children are in childcare or are being monitored by an older sibling while parents at work. Hess also wrote that children are better off attending school in the summer rather than wasting their time at home or in the community. Other advanced nations refrain from providing an American like summer recess (Hess, 2006).

In many cases, parents work to find a way to occupy their children while they are at work (Hess, 2006). A parent cares for only 30% of school-aged children during the summer and according to Hess, typically, families are spending 8% of their summertime earnings to pay for childcare. Simultaneously, expensive school facilities and resources sit idle (Hess, 2006).

Summer Learning Loss

Educational researchers have verified what teachers have been highlighting for years; students forget a considerable amount of knowledge annually each summer. Ballinger and Kneese (2006) stated that communities should be concerned with the amount of time teachers are taking each fall to re-teach the knowledge that has been lost. Children, who are not exposed to continuous learning opportunities throughout the year, and especially in the summer, tend to lose ground academically (Lundstrom, 2005). Unless students are stimulated academically during the 12-week summer recess, they fall behind by roughly 12-weeks in their reading achievement (Lundstrom, 2005). Heaberlin (2002) also acknowledged that most children do not retain their academic knowledge after a 12-week summer break from school. Ballinger (1995) stated the number one reason to change to the balanced school calendar from a traditional school calendar is to eliminate the significant learning loss that happens over summer break.

The summer learning loss impacts lower income children who may already be struggling more than their counterparts from the middle class (Lundstrom, 2005). Disadvantaged students, according to Morse (1992), forget more during summer break than any other child. If this pattern continues, in a few short years, a child could be several years behind, which accounts for 80-100% of the gap between low income children and children from the middle class (Lundstrom, 2005).

Lundstrom (2005) stated 61% of low-income families do not have any books at home and schools offer some of the only resources available to many children. Moving to a balanced school calendar will increase the performance of students that may not have the resources readily available and may not be supported at home (Heaberlin, 2002). If a non-disadvantaged child either maintains an academic level or has the opportunities to gain exposure to literature, the gap between a non-disadvantaged child and a low-income child can become tremendous. The gap that is developed annually due to the length of the summer recess is a contributing factor in the dropout rate across the country (Ballinger & Kneese, 2006). The impact to math is more dramatic to the loss in language arts (Davis, 2006; Schulte, 2009). Heaberlin (2002) reported that summer intermission is most detrimental on math computation.

Traditional calendar schools tend to put at-risk children at a greater disadvantage by holding true to a long summer intermission between school years (Heaberlin, 2002). School officials need to be aware of the unintended consequences of continuing to operate on an outdated school calendar. Kneese and Knight (1995) reported that balanced calendar schools have a significant advantage over their counterparts on the traditional calendar when facing the summer slide. By shortening the 12-week summer recess, schools can minimize the regression caused by the summer recess (Heaberlin, 2002).

Traditional calendar schools tend to disadvantage low-income children by holding firm to an outdated school calendar. The summer recess can amount to the loss of one week of knowledge retention for each week a child is away from school. School officials need to be aware of the unintended consequences of operating schools on an outdated school calendar. Math computation tends to be the area of greatest loss (Heaberlin, 2002).

Summer Recess

Hattie (2009) reviewed 800+ meta-analyses and placed the results of each meta-analysis on a continuum. Hattie contended that each technique to improve student achievement has an effect size and each varies in degree of success. With the baseline often selected to evaluate the effectiveness at 0.0, any increase beyond zero is considered a positive solution to those in the education field (Hattie, 2012). The result, however was that not all interventions are effective and moreover, the real baseline for effectiveness according to Hattie should begin at 0.4 and above. The average effect size for the 800+ Meta analyses was 0.4. By increasing the effectiveness level to 0.4, educators can begin to quantify the effectiveness of educational programming. Hattie (2012) stated that 0.4 is the hinge-point for identifying what is and what is not effective. Setting the bar at an effect size of 0.4 according to Hattie serves as a guiding point from which educators can judge the effectiveness of a program. Hattie argued that setting the bar at an effect size of 0.0 is misleading and dangerous. Educators need to be more discriminating as generally educators feel they are doing an effective job (Hattie, 2009).

Summer recess has been studied in the past. In the early years of formal schooling in America, the format was designed to meet the needs of farming communities (Cooper et al., 1996). Currently only about three percent of American's livelihood can be linked to the agricultural cycles and thus the current call for school districts to modify current school calendars (Hattie, 2009).

Hattie (2009) targeted 39 studies on the impact of summer recess on student achievement. Within the 39 studies, the results of 62 research questions relating to the impact of summer recess on student achievement were analyzed. Hattie determined that summer recess has a negative impact on student achievement. With an effect size of -0.09, Hattie (2009) has determined that summer recess has a negative impact on all children. Hattie also stated that the losses that occur over the summer are greater in mathematics than other academic subjects such as language arts or reading.

At-Risk Students

Summer recess impacts children in different ways (Rozelle & Makenzie, 2011). When students are in session, all students learn at a desired rate (Entwisle, Alexander, & Olson, 1997). The impact of summer recess is greater on the children that have been identified as qualifying for free and reduced meals (Rozelle & Makenzie, 2011). Children in this Midwestern state become eligible for free and reduced meals based on guidelines from Federal Register 19179.

The summer learning loss is greater among at-risk students (Cooper, 2003). The losses compound annually and learning for at-risk children stops during the summer (Smith & Brewer, 2007). On average, at-risk children lost nearly three months of grade-level equivalency during the summer months annually (Smith & Brewer, 2007). Davis (2006) claimed that children from poor neighborhoods are less likely to be involved in quality after-school programs, generally come from homes with limited resources, and tend to struggle from poor health and a transient lifestyle (Davis, 2006). Supporting calendar reform, Davis stated that the best empirical research demonstrates that out-of-school factors influence performance thus fueling summer learning loss. A study conducted by Entwisle et al. (1997) annually tested two groups of children, middle class children and disadvantaged children. The study surfaced the fact that both groups of children made similar progress from fall to spring, however, the gap in the summer became bigger annually (Entwisle et al., 1997).

Faucet Theory

To explain the regression that takes place annually during the summer months, researchers and policy makers typically use the Faucet theory (Borman et al., 2005; Miller, 2007; Rozelle & Mackenzie, 2011). Alexander and Entwisle developed the faucet theory to describe the impact of summer learning loss (Miller, 2007).

> When school was in session, the resource faucet was turned on for all children, and all gained equally; when school was not in session, the school resource faucet was turned off. In summers, poor families could not make up for the resources the school had been providing, and so their children's achievement reached a plateau or even fell back. Middle-class families could make up for the school's resources to a considerable extent…home resources matter mainly…or only in the summer. (Enwisle et al., 2001, p. 12)

During the summer months, the faucet of resources is turned off (Entwisle et al., 2001; Miller, 2007; Rozelle & Mackenzie, 2011). While parents often want to provide the best for their children, Miller stated that there are significant differences between middle-income families and at-risk families. Entwisle and Alexander (1992) found that students living in neighborhoods with high levels of poverty had greater levels of learning loss.

Executive Attention

Several cognitive factors influence a child's ability to learn mathematical concepts, procedures and facts (LeFevre et al., 2013). Of a variety of cognitive predictors, LeFevre et al. stated that memory and attention seemed to be particularly important. Executive attention is described as the common elements of the working memory and attention combining to predict complex cognitive tasks (McCabe et al., 2010). "Executive attention is then deemed important to the development of two broad aspects of mathematical performance…conceptual and procedural" (LeFevre et al., 2013, p. 255). LeFevre et al. also stated that executive attention is vital to conceptual and procedural aspects of mathematics as well as arithmetic fluency. Executive attention is assumed to control the processes that are used during many complex cognitive tasks (Engle, 2002; Kane, Conway, Hambrick, & Engle, 2007). Executive attention is likely to capture individual differences in attention for distinct mathematical operations (Barrett, Tugade, & Engle 2004; Best & Miller, 2010).

Executive attention is important in the development of the working memory of a student (Meyer, Salimopoor, Wu, Geary, & Menon, 2010; Miller & Cohen, 2001). Additionally, executive attention is linked to mathematical knowledge and fluency (LeFevre et al., 2013). Knowledge and fluency are assumed to be two mathematical skills that by second grade, students are using to solve arithmetic problems (Wu, Meyer, & Maeda, 2008).

"Many children begin school with an implicit understanding of aspects of number, counting, and arithmetic" (Meyer et al., 2010, p 101). Executive attention and working memory contribute to their ability to build on the informal knowledge children enter school with (Meyer et al., 2010).

Children who tend to excel in mathematics learning, tend to have high executive attention and working memory capacity and according to Meyer et al., (2010), in second grade as the executive attention increases, the working memory becomes critical for mathematical learning to occur.

Executive attention and working memory have been linked in numerous studies and children who have poor math skills, generally have lower levels of executive attention and working memory (Swanson & Beebe-Frankenberger, 2004). Another study with participants that were seven and eight years old, found that mathematics performance is strongly correlated with the executive attention (Henry & MacLean, 2003). Executive attention facilitates a child's ability to solve mathematic problems by aiding in the selection of appropriate strategies (Barrouillet & Lepine, 2005).

The term mathematical knowledge refers to a child's knowledge of verbal numbers and their knowledge of calculation procedures (LeFevre et al., 2013). Applied to this study, LeFevre et al. stated that executive attention was related to a child's procedural and conceptual knowledge in second and third grade. Further support for selecting children in second and third grade is the fact that procedural knowledge and fluency are most impacted by executive attention and solving complex arithmetic problems requires additional functioning (Hecht, 2002)

Executive attention is a predictor of math knowledge and arithmetic fluency (LeFevre et al., 2013). "Executive attention has a consistent relation to children's learning and performance in mathematical tasks" (LaFevre et al., 2013, p. 257). Executive attention is concurrently related to children's knowledge and fluency, both, which are becoming concrete by second and third grade (LeFevre et al., 2013). The use of executive attention as a predictor of math knowledge and arithmetic fluency is consistent many other studies that have linked similar constructs to mathematical development (Raghubar, Barnes, & Hecht, 2010). Executive attention plays a large role as children monitor and manipulate each situation with shifting rules such as mathematical equations (Fan, McCandliss, Sommer, Raz, & Posner, 2002).

Summary

The purpose of this empirical study is to investigate the relationship between the length of summer recess and mathematical learning retention. The focus is to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

While the current review provides a rich foundation to the benefits of operating a balanced school calendar, the intent was to help district level stakeholders become more familiar with the literature supporting the change. Schools can no longer be satisfied with the status quo. In an ever-changing environment, schools must continue to look for answers to minimize the summer learning loss (Ballinger, 1995).

When stakeholders consider a move to the balanced school calendar, community members view the decision makers in a positive public image (Shields & Oberg, 1999). The balanced school calendar has a positive influence on all stakeholders (Haser & Nasser, 2005).

Achievement gaps exist between schools across America. Without structural changes, many schools will continue to lag behind state averages on standardized assessment tests. There is a need to do more research on the impact of balanced calendar schools and the summer learning loss. Additionally, there is a need to understand if differences exist from traditional calendar schools in achievement levels in mathematics.

Developed as a theory to help describe why all children lose knowledge over the summer, faucet theory is often used to explain the summer learning loss. Faucet theory in this study is used to provide a foundation why the summer learning loss occurs annually. As a result, educational leaders should consider adopting the balanced school calendar as a method to combat the summer learning loss.

Executive attention was used to defend the selected population and as applied to this study, (LeFevre et al., 2013) is related to a child's procedural and conceptual knowledge in second and third grade. Further support for selecting children in second and third grade is the fact that procedural knowledge and fluency are most impacted by executive attention. To solve difficult arithmetic problems such as complex equations requires additional functioning (Hecht, 2002), which this study does not intend to assess.

Hattie (2009) determined through several meta-analyses that summer has a negative impact on all learners. With an effect size of -0.9, educational leaders should consider options to reduce the negative impact of summer recess.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

This pre-test/post-test, quantitative comparison study is considered predictive quasi-experimental research (Roberts, 2004). Comparative research is used when a true control group cannot or should not be examined (Gay, Mills, & Airasian, 2011) and a comparison group is used instead. In addition, comparative designs are most often used in educational research studies (Gay et al., 2011) since the manipulation of a control group will be unethical. Quasi-experimental designs are used to approximate the advantages of an experiment where participants are assigned to a group (Muijs, 2011). For this study, the results from the math benchmark assessments from students who attend a school with a six-week summer recess were compared with the results from those students who attend a school with a 12-week summer recess. By adopting a post-positivist worldview (Creswell, 2009), this study was conducted to determine whether the length of summer recess had an impact on mathematical learning retention of students in grades two and three. A framework (Appendix D) served as a guide for this study.

Population

The selected population for this study were elementary children in the United States of America. More specifically, second and third grade children that attended school in the spring of 2014 and again in the fall of 2014 were selected.

Sample

I targeted students in a Midwestern state from one suburban school district. Half of the population attended school on the traditional school calendar with a 12-week summer recess and the other half of the population attended school on a balanced school calendar with a six-week summer recess (Appendix E). Muijs (2011) stated that when using a quasi-experimental design, a comparison group is recommended, as it is difficult in this setting to identify a pure control group. In order to retain the advantages of experimental designs, it is imperative that the two comparison groups are as similar as possible (Muijs, 2011). The selected students in this study attended schools within the same school district. The selected schools had a similar free and reduced lunch percentages and similar achievement levels based on the state education assessment program test. Table1 further describes the similarities in the selected schools. Pseudonyms have been used for each school. The school operating on the traditional calendar will be considered North School. The school operating on the balanced calendar will be considered South School.

Table 1. 2013-14 Math State Education Assessment Program Test and Free and Reduced Lunch Results

School	3rd Grade Math State Proficiency Score	4th Grade Math State Proficiency Score	Free and Reduced Lunch Percentage
North School (Traditional)	49%	52%	59%
South School (Balanced)	60%	39%	60%

(MDE, 2014b)

Each school had a similar teaching staff. The selected schools each had three or four separate classrooms of second grade and three classrooms of third grade. Each classroom was at or near capacity with limits of 25-27 children. In this district, the teacher contract establishes capacity numbers for each classroom. The classroom maximum is 25 students in second grade and the capacity grows to 27 per class in third grade. Each school has a blend of experience levels teaching both second and third grade. The second and third grade teachers in North School averaged 15 years teaching experience. At South School, the experience level was closer to seven years of average experience teaching.

The overall student populations were similar as described in Table 2 and each school had a stable population during the school year and somewhat transient between school years. Both administrators described their populations as 80% stable.

Table 2. Description of Each Selected School

School	Number of Teachers in Second and Third Grade	Average Years of Teaching Experience	Number of Students Enrolled	Population Description Stable or Transient
North (Traditional)	8	15	445	Overall Stable
South (Balanced)	7	7	400	Overall Stable

(HPS, personal communication, 23, May, 2014)

I used purposeful sampling to identify and select the schools. Only second and third grade students with parental consent participated. In this study, approximately 200 second and third graders from a traditional calendar school and approximately 175 students from a balanced calendar school were invited to make up the sample. The actual total sample size *N*=237 included 120 female students and 117 male students. Creswell (2009) stated that purposeful sampling is appropriate when a selected site or a selected group of individuals have been identified that will best help the researcher answer the research questions.

Data Collection

Students in second and third grade were pre-tested and post tested. I collected the data in two phases. Initially, I collected the M-COMP data in the final week of school prior to summer recess for each participating classroom. During the first week of school following summer recess, I reassessed students in both groups using the same protocol. To identify the number of children who participated in summer math enrichment programming such as math, space, or engineering camp, correspondence math programs such as Grand Rapids Academic School Program (GRASP), or worked on online programs such as *Xtra Math*® or *Study Island*®, I included a brief seven question survey to the post-test (Appendix B).

The school board and superintendent in the district granted permission to complete this community based research subsequent to receiving human subjects approval. Faculty members were made aware of the purpose of the research as well as the benefits and risks associated with this line of inquiry and the participants have completed a consent form. Parents of the participating children *(N=237)* granted permission. Although the entire population (n=375) of second and third grade students at both schools were invited to participate, 38% (n=142) failed to return consent forms granting permission, therefore, were not include in this study. I also gained assent for the study from the participating children. To provide a level of confidentiality, each instrument was assigned a code matching a class roster. A key matching the participants to a test was stored in a locked cabinet in the researcher's office. During and after all data were collected, data were stored in a locked cabinet and kept in a password-protected file. Five years after the publication of the study, the data will be destroyed.

Variables in Research Question #1

The dependent variable in this study was mathematical learning retention; this was measured by analyzing the AIMSweb Benchmark results from students using a pre-test, post-test model. The independent variable in this study was the length of summer recess (six-weeks or 12-weeks). I analyzed results from the AIMSweb mathematics (M-COMP) tests and aggregated the test score data to the year, school, and grade level. In this study, M-COMP scores from students attending schools with a six-week summer recess were compared to scores from students with a 12-week summer recess as shown in Figure 1. The dependent variable was continuous and the independent variable was categorical.

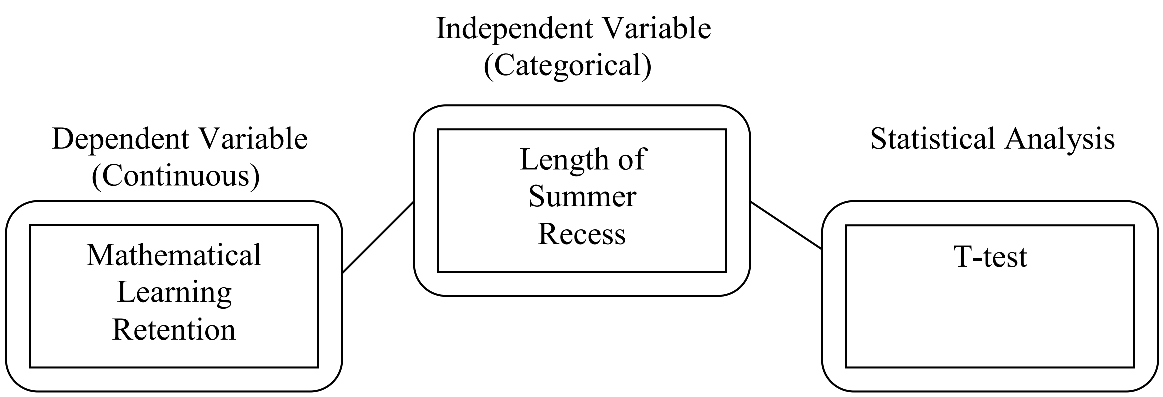


Figure 1. Analysis Framework for Research Question #1
Note: This inquiry includes a continuous dependent variable and a categorical independent variable. As a result, a t-test was used to analyze this particular research question.

Data Analysis for Research Question #1

Descriptive statistics were used to provide a summary as this type of data can be used to organize large amounts of quantitative data in a manageable form (Muijs, 2011). The summary typically includes the sample size and number of responses. I analyzed these data using SPSS® software, version 22. Descriptive statistics offered the researcher the first look at the quality of the data and helped to guide additional analysis (Muijs, 2011). Looking at the relationship between two variables is considered a bivariate analysis (Muijs, 2011). Muijs recommended this analysis when looking for statistical significance and when in quest of the strength of the relationship.

Finally, a paired-samples T-test was conducted to determine if there is a significant relationship between the independent variable, the type of school in which a child is enrolled, and the dependent variable, student mathematical learning retention. Pallant (2013) stated that paired-samples T-tests are suited for studies with independent categorical variables when compared to a dependent continuous variable. Pallant further noted that a paired samples T-test is used to assess whether the means of two groups are statistically different from each other. Furthermore, a paired-samples T-test helps predict the likelihood of an event occurring if there is a relationship between variables. Paired-samples T-tests are often used when a researcher is interested in changes in scores when participants are tested on two different occasions (Pallant, 2013). In this case, I compared the M-COMP scores for students enrolled in a school with a six-week summer recess (balanced calendar) and a school with a 12-week summer recess (traditional calendar school). Second and third grade students took the AIMSweb M-COMP test at the end of the school year. The students from both groups took the same assessment approximately 42-84 days later.

Variables in Research Question #2

The dependent variable in research question two is mathematical learning retention; this was measured by analyzing the AIMSweb Benchmark results from students using a pre-test, post-test model. The independent variables to answer this research question in this study were economic status of each student, gender, participation in summer intersession, and the type of school calendar attended. I analyzed results from the AIMSweb mathematics (M-COMP) test data to the year, school, and grade level. In this study, M-COMP scores from students attending schools with a six-week summer recess were compared to scores from students with a 12-week summer recess as shown in Figure 2. The dependent variable was continuous and the independent variables were categorical.

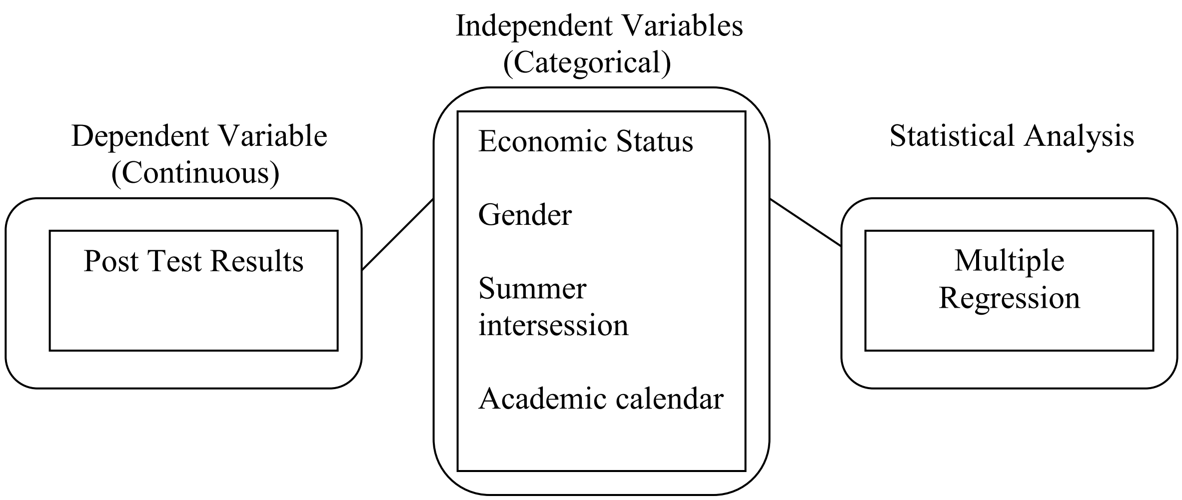


Figure 2. Analysis Framework for Research Question #2
Note: This inquiry includes a continuous dependent variable and a categorical independent variable. As a result, a multiple regression was used to analyze this particular research question.

Data Analysis for Research Question #2

Descriptive statistics were again used to provide a summary as this type of data can be used to organize large amounts of quantitative data in a manageable form (Muijs, 2011). The summary typically included the sample size and number of responses. I analyzed the results using SPSS® software, version 22. While analyzing the relationship between the variables, I conducted a multiple regression (Muijs, 2011). Muijs recommended this analysis when looking for statistical significance and when in quest of the strength of the relationship.

Finally, the multiple regression was conducted to determine if there is a significant relationship between the independent variables, economic status, gender, attendance in summer intersession, and academic calendar and the dependent variable, student the post test results. Pallant (2013) stated that multiple regression analysis is suited for studies with several independent categorical variables when compared to a dependent continuous variable. Pallant further noted that a multiple regression is based on a correlation, but typically allows for a more sophisticated view of the relationship between a set of variables. Furthermore, a multiple regression helps predict the likelihood of an event occurring if there is a relationship between variables. In this case, I compared the M-COMP post-test scores for each student as compared with the economic status of the sample, the gender of the selected students, whether or not a student received remediation or enrichment over the summer, and the academic calendar for each participant. Second and third grade students took the AIMSweb M-COMP test at the end of the school year. The students from both groups took the same assessment approximately 42-84 days later.

Limitations

According to Dereshiwsky (1999), limitations are threats to the internal validity of a study. Typically the limitations are outside the control of the researcher (Roberts, 2004). In this study, I have identified four factors which may be considered limitations, thus jeopardizing internal validity: 1) a controlled environment, 2) preparedness of each student, 3) recent economic issues in this Midwestern state, and 4) how long a student has been attending each particular school. I attempted to control for the limitations by using a standardized instrument, selecting children from the same school district, and seeking a population that was somewhat stable.

Delimitations

Delimitations refer to external validity or how well the findings can be generalized outside of the group that was studied (Dereshiwsky, 1999). In most cases, Roberts (2004) indicated that delimitations are controllable by the researcher. In this study, I have identified three delimitations which may jeopardize the external validity of this study: 1) Only results from two schools were included in the study; 2) the size of the population of this study may prevent it from being transferable or generalizable due to the ongoing changes at the federal, state, and local levels; and 3) This study was limited to the impact the length of recess has on mathematics learning retention for second and third graders.

Summary

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

The pre-test/post-test comparison study was considered descriptive and comparative quasi-experimental research (Roberts, 2004). Quasi-experimental designs are used to approximate the advantages of an experiment when a true experiment would be harmful to a control group (Muijs, 2011). Student test results from a balanced calendar school will be compared with the student test results from a traditional calendar school on a standardized math test called the M-COMP.

I assessed children in second and third grade children in one Midwestern suburban school district. A purposeful sampling has been identified from which to select the participants. Creswell (2009) stated purposeful sampling is best applied when a selected group of individuals have been identified to help the researcher answer the research questions. In this study, the dependent variable was mathematical learning retention. The independent variable was the length of summer recess: 12-weeks or six-weeks.

I analyzed these data with SPSS® Version 22 software. Descriptive statistics and a paired-samples T-test were applied to determine if there was a significant relationship between the independent variable, the type of school in which a child is enrolled and the dependent variable, student achievement on the M-COMP.

To answer the second research question, I analyzed these data with SPSS® Version 22 software. Descriptive statistics and a multiple regression were applied to determine if there was a significant relationship between the independent variables, economic status, gender, participation in summer intersession, and academic calendar and the dependent variable, student achievement on the M-COMP.

This study was intended to determine the relationship between the types of school in which a child was enrolled and how much knowledge was lost over the summer on mathematic computation skills. Several limitations and delimitations were identified.

Teachers acknowledge the impact of summer learning loss (Ballinger & Kneese, 2006). As a result, traditional calendar school teachers typically spend 20-40 school days each fall to review curricular material that had been previously taught and assessed the year prior (Ballinger & Kneese, 2006). Ballinger and Kneese stated that the balanced school calendar offers the same number of instructional days as that of their counterparts on the traditional school calendar. A visual representation is presented to further explain the difference between the calendars being compared in this study (Appendix E).

CHAPTER IV

DATA ANALYSIS AND RESULTS

Introduction

The results of this study are reported in this chapter. A summary of the participant group along with a description of the analyses is provided. Initial permission for this study occurred at multiple locations. The university's Institutional Review Board as well as the superintendent and school board of the Midwestern school district granted permission for research to be conducted, as there were no known risks to the participants. All data collected were stored in a secured location to protect the confidentiality and anonymity of each participant. Pseudonyms were assigned to each school.

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

Reliability and Validity

Pearson's AIMSweb received the highest possible rating for predictive validity and reliability from the National Center on Response to Intervention (NCRTI, 2009). The National Center on Intensive Intervention (n.d.) stated results were randomly drawn from the national test sample, scored by independent raters and have been determined that with intraclass correlation which reflects consistency and reliability. To determine if the instrument was valid, mathematical experts were engaged in analyzing the assessment and when all data were aggregated, the assessment was deemed standardized. In both cases, reliability and validation were consistently being scrutinized. Table 3 describes the reliability and validity of the M-COMP benchmark assessment.

Table 3. Descriptive and Reliability Statistics by Grade (Pearson, n.d.)

Grade	Mean*	SD[b]	SEM[c]	r[d]	Split-Half[d]	Alpha[d]
1	36.0	12.8	4.02	.86	.89	.87
2	37.9	11.4	4.04	.82	.85	.82
3	51.2	17.6	4.67	.89	.90	.89

* Weighted average.
b Pooled standard deviation
c Average correlation coefficient and the actual standard deviation of the raw score for the probe
d The average reliability coefficients were calculated by using Fisher's z transformation.

Descriptive statistics have purpose in describing the characteristics of the sample, for checking for any violations of the assumptions that are being used to address the research questions, and supporting each specific research question (Pallant, 2013). Descriptive statistics give a quick summary of the data file being analyzed (Pallant, 2013). The descriptive statistics for this study were helpful in ensuring there were no errors in the data file.

Descriptive Statistics

This study was conducted to test the significance of summer recess on the retention of mathematical computation skills. Participants (*N*=237) completed both the pre-test and the post-test. The population included 120 girls and 117 boys. All of the participants were in either second (*n*=117) or third grade (*n*=120) during the pre-test and were promoted to the next grade following summer recess. A brief survey was conducted prior to the post-test to determine whether or not a participant received remediation or enrichment over the summer in mathematics. Findings revealed that only 7% of the surveyed children (*n*=16) participated in a summer program for remediation or enrichment in mathematics. The participants in the study attended two different schools within the same school district that operate on different academic calendars. Of the total *N*=237 participants in the study, 54% *(n=127)* attended a traditional calendar school, while the remaining 46% *(n=110)* attended a balanced calendar school. In a determination of socioeconomic status, 42% *(n=99)* of the participants were full paying lunch students, while 58% *(n=138)* of the students were eligible for free and reduced lunch. Further defining the at-risk population, 54% *(n=75)* of the students attended North School (traditional) while 46% *(n=63)* of the students attended South School (balanced). The percentage of free and reduced children in the study mirrors the overall free and reduced lunch status of each school.

Testing the Research Questions

Research Question # 1

To what extent does the length of summer recess impact student mathematical learning retention? The M-COMP benchmark assessment was administered to second and third grade children the last week of school prior to summer recess and again using the same assessment following the summer recess. The raw scores were entered into SPSS® Version 22 software for analysis. A paired-samples t-test was used to determine if there was a statistically significant difference between students who attended a traditional school calendar as compared to their counterparts on the balanced school calendar. After the paired-samples t-test analyses were conducted, the results indicated that there were significant declines in test scores from spring to fall for children who attended a traditional calendar school.

Table 4. Mean Test Results

School	Pre-test Mean (Spring)	Post-test Mean (Fall)	Mean Difference
North School (Traditional)	41.94	34.03	7.913
South School (Balanced)	42.88	40.11	2.773
Overall			5.527

Paired-samples t-test analyses were conducted and the results indicate that there were declines in test scores from the pre-test to the post-test as a result of summer recess for all children. Overall losses occurred regardless of the school a participant attended, however, when comparing the two academic calendars, the participants who attended school on the balanced calendar scored on average 5.527 points better than their counterparts on the traditional school calendar when comparing mean scores as shown in Table 4. Students who attended North School (Traditional) regressed on average by 7.913 points on the M-COMP due to the 12-week summer recess as compared to children who attended South School (Balanced) that only regressed on average 2.773 points on the pre-test/post-test assessment.

Statistical significance was determined as a result of the paired-samples t-test and resulted in $p<0.05$. This showed that the results determining that children attending the balanced school calendar lose fewer mathematical computation skills over the summer as compared to their counterparts who attend a traditional school calendar and have a 12-week summer recess did not occur by random chance or the result of just this particular sample.

Research Question # 2

Is there a relationship between student mathematical learning retention and economic status of students, gender, intersession attendance, and academic calendar? The M-COMP benchmark assessment was administered to second and third grade children the last week of school prior to summer recess and again using the same assessment following the summer recess. The raw scores were entered into SPSS® Version 22 software for analysis. A multiple regression was conducted to determine if there was a relationship between student mathematical learning retention and economic status of students, gender, intersession attendance, and academic calendar.

Table 5. Multiple Regression Results of Research Question #2

Model	Unstandardized Coefficients(a)		Sig.
	B	Std. Error	
(Constant)	-3.947	1.247	0.002
Gender: Male	0.308	0.685	0.654
South School (Balanced)	5.082	0.683	0.000***
Economic Status	-1.308	0.699	0.062
Pre-test	0.910	0.024	0.000***
Participation in Summer Intersession	6.935	1.353	0.000***

***$p<0.05$

(a) Dependent Variable: Mathematical Learning Retention (post-test results)

In order to answer the second research question, a multiple regression was conducted to determine if there was a significant relationship between the independent variables economic status, gender, and participation in summer intersession, and academic calendar and the dependent variable, student post-test results.

In this case, the data do not demonstrate statistical significance for economic status as the result of the regression $p<0.062$. Therefore table 5 illustrates that children who received free or reduced lunch (economic status) had similar results regardless of which academic calendar they attended.

Gender

Relevant to this study, gender and attendance in summer intersession were also analyzed. In the case of the type of calendar, gender is not a significant factor when considering the type of school a student attends. The significance level for gender were $p<0.654$, which is not considered significant. Previous research regarding mathematics and gender has indicated that boys typically outperform girls on mathematic assessments (Bracey, 1994; Ganley & Vasilyeva, 2011). The results from this study contradict that research.

Intersession

Only 16 students in the entire population attended a mathematical remediation or enrichment opportunity over the summer, also known as summer intersession. Although the number of participants was low, children who participated in mathematical summer intersession scored better than their counterparts who did not. The significance level for children attending a summer intersession opportunity over the summer was $p<0.000$. A case can be made that mathematical instruction in the summer regardless of the type, remediation or enrichment, reduces the impact of summer recess.

Type of School

The multiple regression analysis demonstrated a significance level of $p<0.000$ for the type of calendar the participants attended. As a result of the significance demonstrated, all children who attended the balanced calendar school scored better on the M-COMP than their counterparts attending the traditional calendar school. A result that achieved a level less than $p<0.05$ was interpreted as significant (Table 5).

Pre-test

With a significance level of $p<0.000$ for the pre-test, the multiple regression analysis demonstrated that all participants scored better on their pre-test on average than on their post-test. Regardless of the type of school calendar a student attends, all children scored higher on the pre-test which was assessed the last week of school in June than their post-test results in August and September respectively. Reducing the summer recess should be a priority for administrators, policy makers, and community members interested in increasing student achievement.

Summary

Information reported in Chapter IV responded to two central research questions for this study. This study was conducted in two parts in two different schools within the same Midwestern suburban school district.

1. To what extent does the length of summer recess impact student mathematical learning retention?

Results from the paired-sample t-test described participants attending a balanced calendar school outperformed their counterparts who attended a traditional calendar school. In this case differences in mean scores were analyzed and the balanced calendar students regressed 2.773 points as compared to their counterparts on the traditional school calendar who regressed 7.913 points between the pre-test and the post-test. As a result, students in this study attending a balanced calendar school retained more mathematical computational skills than their peers attending a similar demographic school operating on a traditional calendar. A total mean decline between the two separate schools was 5.527 (Table 4). Children attending a balanced school calendar retained more mathematical computation skills than their counterparts on the traditional calendar. As a result, reducing the length of summer recess may be considered to positively impact the retention of mathematical knowledge for second and third grade students.

2. Is there a relationship between student mathematical learning retention and economic status of students, gender, intersession attendance, and academic calendar?

Results from the multiple regression demonstrated that there was no significant relationship between at-risk children attending the balanced school calendar and those who attend a traditional school calendar.

Although there was no significance $p<0.654$, according to the multiple regression regarding economic status, the results of the statistical analyses indicated that regardless of at-risk status measured by free and reduced lunch data, all children benefit from the balanced school calendar when measured on a mathematical computation test.

Additionally the data indicated that gender has no significance on test scores in this study. Regardless of gender, boys and girls demonstrated similar results.

Although the sample was extremely small, 16 children either received mathematical remediation or enrichment during a summer intersession experience. As a result of summer math programs, participants who received mathematical remediation or enrichment benefited from those activities and outperformed their counterparts who did not receive any instruction. The level of significance for the participants that received summer programming was $p<0.000$.

Based on these findings, it appears that students who attend a balanced calendar school with a six-week summer recess retain more mathematical computation skills than their counterparts who attend a traditional calendar school with a 12-week summer recess. The impact of the length of summer recess on mathematical computation skills was significant. In this study, findings indicate that all participants benefited from a shortened summer recess when measured by retention of mathematical computational skills. In addition, a small group of children received additional math enrichment or remediation during the summer. Regardless of the type of school attended, all children in this study who received additional supports in math scored better than their counterparts who did not receive any instruction over the summer. A level of significance of $p<0.000$ was determined which is considered statistically significant. Contrary to previous studies significance was not established for subgroups such as gender or economic status. It should be noted that this study did not control for enrichment or remediation during the school year; therefore, challenging the faucet theory warrants further research.

Regardless of sex and type of school, this study did not demonstrate a significant finding when comparing gender. In addition, the faucet theory developed by Entwisle, et al. (1997) explained the impact summer has on children considered at-risk due to their economic status; however, this study demonstrated that all children benefited from a six-week summer recess when compared with like peers who attended a traditional school calendar with a 12-week summer recess.

CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter outlines the summary of the study, the discussion, conclusions, and recommendations forth coming from the data. Recommendations for future research are also presented in this chapter.

Administrators and teachers across the nation have been actively seeking solutions to minimize the impact of summer recess on student achievement. Students appear to lose the equivalent of one month of instruction per summer annually (Ferguson, 1999). Hayes and Grether (1983) stated that summer recess equals a three-month loss of achievement.   Over the course of a typical school experience, the gaps that are identified at the secondary level can be attributed to the negative impact of summer recess on academic achievement (Hayes & Grether, 1983). As a result, school officials have been left with the burden of investigating ways to minimize the summer learning loss that occurs annually.

Educators and policy makers in the United States should consider the school calendar of the top five performing nations on the 4th grade TIMSS assessment (Appendix A). Schools in each of the top performing nations operate on a balanced school calendar; each country has a school calendar that mandates children attend school between 190-243 days annually. As a result, in both cases, school officials in America are considering an alternative school calendar to increase student achievement and minimize the losses that occur annually due to summer recess.

The need to change the structure of the school calendar has been met with resistance in the past due to the common experience the majority of Americans experienced while attending school (Rury, 2013). The concept of the balanced school calendar dates back to the early 1645, however it was not until the 1980s when the balanced calendar began to be adopted by school districts across the nation. Initially used to alleviate overcrowding, balanced school calendars have been tied to inconclusive results and in some cases conflicted findings (Glines, 1995). Glines also stated that current information on an alternative school calendar is somewhat inconclusive and can be considered biased.

Although once considered biased and conflicted, the results of this study demonstrate the length of summer has a significant impact on mathematical learning retention for second and third grade children. When seeking ways to mitigate the impact of summer recess on mathematics, stakeholders should consider the following discussion. In addition, this study gives policy makers the statistical data needed to advocate for a shorter summer recess based on empirical evidence.

Discussion of Key Findings

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade students in mathematics achievement in a Midwestern state.

This study was conducted in a Midwestern state from one suburban school district. Half of the sample attended school on the traditional school calendar with a 12-week summer recess and the other half of the sample attended school on a balanced school calendar with a six-week summer recess. The selected students in this study attended schools within the same school district. The selected schools had similar free and reduced lunch percentages and similar achievement levels based on this state's education assessment program test.

The results of this study demonstrate that regardless of economic status and gender, children who attend a balanced school calendar with a summer recess of six-weeks retain more mathematical knowledge than their counterparts who attend school on the traditional school calendar with a 12-week summer recess. Furthermore, children who received some mathematical instruction while on summer recess retained more mathematical knowledge as compared to their peers who did not receive instruction during summer recess. Finally the length of summer recess has a significant impact on mathematical retention. All children in this study who attended the balanced school calendar outperformed their counterparts on the traditional school calendar.

Executive Attention

The length of summer recess impacts the executive attention. Several cognitive factors influence a child's ability to learn mathematical concepts, procedures, and facts (LeFevre et al., 2013). Of the cognitive factors, LeFevre et al. stated that memory and attention are most important. Executive attention is described as the common elements of the working memory and attention combining to predict cognitive tasks (McCabe et al., 2010). Thus, executive attention is linked to mathematical knowledge and fluency (LeFevre et al., 2013). Both knowledge and fluency are assumed to be mathematical skills that by second grade are used to solve arithmetic problems. Executive attention and working memory have been linked to numerous academic studies and children who have poor math skills, generally have lower levels of executive attention and working memory (Swanson & Beebe-Frankenberger, 2004). Mathematical performance is most strongly correlated with executive attention (Henry & MacLean, 2003). Ultimately, the M-COMP fluency test assessed the automization of arithmetic facts of second and third grade children at the end of one school year and again following the summer recess the first week of school the next school year.

The results of this study demonstrate that the length of summer has an impact on executive attention. The longer a student is on summer recess, the more the executive attention is impacted. Demonstrated by significance levels of $p<0.000$ for type of calendar a student attends and $p<0.000$ for children who received summer remediation or enrichment, a case can be made that the length of summer recess has a significant impact on the executive attention of each participating student. Transitioning to an academic calendar with a six-week summer recess may produce increased levels of mathematical knowledge retention. When looking for ways to increase student achievement and minimize the losses that occur annually following summer recess, according to this study, a modified school calendar with a shorter summer is one answer.

Summer Recess

This study has confirmed what practitioners working on the balanced school calendar believe about the impact of summer recess on learning retention. The length of summer recess has a significant impact on mathematical learning retention. This study was conducted to test the significance summer recess had on the retention of mathematical computation skills. Participants completed both the pre-test and the post-test. The sample included 62% of eligible second and third grade students in two different schools that operate two different school calendars. Initially, the data from Pearson, Inc. M-COMP were collected in the final week of the school year from children who attend school on two different school calendars. The same children were post-tested during the first week of school the following August or September using the same assessment, following a short survey (Appendix B).

Following the statistical analyses, it was determined by a paired-samples t-test and confirmed by a multiple regression that all children who attended the balanced school calendar in this study retained more mathematical computational skills as compared with a similar population that attended school on the traditional school calendar. A significance level of $p<0.000$ was identified by the multiple regression indicating a strong statistical significance. The mean scores on the paired-samples t-test indicated a difference of 5.527. Children who attended South School (balanced) regressed on average 5.527 points less than their similar peers who attend school at North School (traditional). These results give policy makers and educational leaders empirical evidence to support the balanced school calendar.

Gender

This study examined the role that gender has on mathematical learning retention and the length of summer recess. Previous research regarding mathematics and gender has determined that boys typically do better than girls on mathematic assessments (Bracey, 1994; Ganley & Vasilyeva, 2011). At all ages, boys scored higher than girls on mathematical assessments (Bracey, 1994). The results from this study challenge that research.

The results of the multiple regression indicated there was no significant difference in performance between boys and girls. With a $p<0.654$, this study indicated that regardless of gender, boys and girls performed in a similar way.

With curriculum enhancements, ongoing assessments, and intervention support for children who are underperforming their peers, it is feasible that teachers are doing a better job targeting instruction and offering timely remediation to impact achievement gaps on a daily basis. With respect to gender and type of school attended, it has been determined that there is no significant difference in mathematical learning retention based on gender and school a student attends. This finding warrants additional study to determine whether these findings could be generalized to a larger population, whether a balanced school calendar can serve to mitigate the previously declared mathematics achievement gap between boys and girls.

Economic Status

An overabundance of literature has been written on the faucet theory. Faucet theory was developed on the premise that when children are in school, regardless of their economic status, all children learn at the same rate (Entwisle, et al., 1997). When students are on summer recess, children from middle to upper class families continue to receive enrichment through experiences that their at-risk counterparts do not experience during the summer recess, thus creating a larger discrepancy between the middle and upper class students and their at-risk counterparts annually. With faucet theory in mind, a second research question was tested. Surprisingly, the results of the multiple regression analyses indicated economic status had no significant impact on the outcome. It should be acknowledged that this study did not control for academic enrichment or interventions at the student level during the school year, therefore, further investigation into the impact summer recess has on at-risk student is necessary. In this case, as a result of the regression $p<0.062$, at-risk students in this study did not score at a level considered statistically significant, which appears to be in contradiction with the principles of the faucet theory.

Proponents of the balanced school calendar know that regardless of economic status, the balanced school calendar promotes learning throughout the entire year for all children. Although the faucet theory promotes a shorter summer for at-risk students, this study demonstrates that a shorter summer recess has a positive impact on mathematical retention regardless of economic status. It is assumed that due to the results of this study, a shorter summer recess benefits the retention of mathematical computation skills for all students thus challenging the faucet theory. These results give credit to the benefits of a shorter summer recess for all children. With funding becoming available for schools to pilot year-round programs in this Midwestern state, school districts should give serious consideration to a transition to a balanced school calendar.

Summer Intersession

Hayes and Grether (1983) stated that summer recess equals a three-month loss of achievement. Although summer typically has a negative impact on retention of knowledge, this study demonstrated that by offering students instruction during the summer, the loss that typically occurs as a result of summer recess could be minimized. This study only had 16 students who attended a mathematical remediation or enrichment opportunity over the summer also known as summer intersession. Although the number of participants who engaged in academic activities during the summer was low, children who participated in mathematical summer intersession scored better than their counterparts who did not. The significance level for children attending a summer intersession opportunity over the summer was $p<0.000$.

The achievement gap that exists in schools across the nation is nearing epidemic levels (Maher, 2001). As a result, minimizing the impact of summer recess has become a focus of school officials across the country. A case can be made that instruction during the summer regardless of type, remediation or enrichment; can mitigate the losses that typically occur annually. School districts across the nation should consider providing math sessions during the summer to minimize the impact of summer recess on learning retention. Despite a small sample, this study endorses the benefits of intersession for those students. Intersessions are one of the most impactful advantages of the balanced school calendar (Ruggiero, 2008). Offering some instruction during the summer can reduce the amount of loss that occurs annually in math according to the results of this study. When policy makers and administrators are considering elimination of summer school programs, this study supports the need to keep children connected with the curriculum. This finding also indicates the need for further study to strengthen the case for intersession instruction.

Type of Academic Calendar

Answering the first research question, to what extent does the length of summer recess impact student mathematical learning retention, involved analyzing the data collected. The length of summer recess has a significant impact on mathematical learning retention for all children who participated in this study. Students in this study who attended school on a balanced school calendar retained more mathematical computation skills than did their counterparts who attended school on the traditional school calendar.

Results from the paired-sample t-test described participants attending a balanced calendar school outperformed their counterparts who attended a traditional calendar school. In this case differences in mean scores were analyzed and the balanced calendar students regressed 2.773 points as compared to their counterparts on the traditional school calendar students who regressed 7.913 points between the pre-test and the post-test. In other words, all children are impacted by summer recess. In this study, it has been determined by a paired-sample t-test and confirmed by a multiple regression that attending a balanced school calendar has a positive impact on mathematics learning retention of second and third grade students. A statistical significance $p<0.000$ has been demonstrated by the results of this study.

As a result, students in this study attending a balanced calendar school retained more mathematical computational skills after summer recess than their peers attending a similar demographic school operating on a traditional calendar. A total mean decline between the scores of students attending two separate schools was 5.527 (Table 4). Children attending a balanced school calendar retained more mathematical computation skills than their counterparts on the traditional calendar. Reducing the length of summer recess has been shown to have a positive impact on the retention of mathematical knowledge for the students in this study.

This study confirms what balanced school calendar proponents have known for years; the type of school calendar has a significant impact on students' retention of knowledge. Hayes and Grether (1983) state that teachers need to re-teach the knowledge lost over summer recess for up to six weeks annually. Over the course of grades one through six, the need to re-teach six weeks annually after summer recess results in1.5 years of learning loss (Hayes & Grether, 1983).

Administrators and teachers across the nation seeking solutions to minimize the impact of summer recess on student achievement should consider a transition to the balanced school calendar. The results of this study have implications for the achievement gap and substantiate that the balanced school calendar is good for all children.

Not included in this study but worthy of acknowledgement are teacher and community attitudes and support for a particular school calendar. Haser (2009) indicated that teachers working on an alternative calendar such as the balanced school calendar reported less stress and improved job satisfaction. A satisfied and refreshed teacher may have contributed to the results of this study.

Also missing from this study are teacher perceptions, student perceptions, and community support for modified school calendars. Although the statistics add context, stakeholder perceptions and attitudes could be relevant to a comprehensive understanding of the benefits of a modified school calendar, such as a balanced school calendar.

This study did not account for the fact that participants at South School (balanced) may have attended intersession over the course of the school year. Intersession classes are typically held during the scheduled breaks and children who attended the balanced school calendar may have had additional instruction over their counterparts on the traditional calendar.

The attendance records of each student were not included in this study. It is likely that not all participants were in school every day during the 2013-14 school year, thus creating a variance in the number of instructional days each child received math instruction. It was assumed that during the pre-test and post-test that all participants were healthy and not suffering from any illness that would alter their performance. Testing for this variable would be difficult as attendance records are limited to excused and unexcused.

Summer recess once made sense (Hess, 2006). When academic achievement mattered less and help was needed on the local farms, summer recess allowed for children to work in the community (Hess, 2006). Hess continued to state that in that era, educators across the nation believed that too much schooling would have a negative impact on the student and the teacher. As a result, the traditional school calendar remains the dominant calendar in place across the nation. Currently, 4.1 percent of the students in America attend a school with a modified balanced school calendar (Will, 2014).

Conclusions

The results of this study indicate that the length of summer recess has a significant impact on mathematical computation retention for second and third grade students. As a result, students who attended a balanced school calendar retained more mathematical computation skills than their counterparts on a traditional school calendar. The findings suggest statistical significance for children who attend school on an alternative school calendar where summer recess is limited to a single six-week summer recess.

According to the findings of this study, the economic status or gender of the participants does not have a significant impact on mathematical computation retention regardless of the type of school calendar attended. This is in contradiction to previous research comparing overall student achievement between students on the balanced school calendar and their counterparts on the traditional school calendar. This study challenges the Faucet Theory Entwisle et al. (1997) and appears to demonstrate that gender differences on mathematical assessments may warrant further study. Noting that this study did not control for academic enrichment or interventions, further research is needed to challenge the Faucet Theory outright.

There was a significant finding for the small sample of children who received enrichment or remediation over the summer recess. Students who had some math instruction in the summer scored better than their counterparts who did not receive enrichment or instruction.

As a result of the findings of this study, it has been determined that the length of summer recess has a significant impact on mathematical retention for all children in the study. It can be assumed that an alternative school calendar such as the balanced school calendar where the longest consecutive summer break must be no longer than six-weeks long has a positive impact on mathematical computation skills. It can also be assumed that when students receive some instruction in the summer regardless of remediation or enrichment, their ability to retain mathematical computational skills increases.

Various stakeholder groups will benefit from the results of this study. The intended purpose of this quantitative study was to provide policy makers, school board members, school administrators, teachers, and community members data about the relationship between the length of summer recess and student mathematics achievement. In this case, the findings may also be useful to colleges and universities for curricular development in administrator preparation programs. The results of this study have produced recommendations, future research, and should help change current perceptions of the impact of summer recess on mathematics skills retention. “Summer vacation is a grand thing. But in the twenty-first century, for many children, it may also be an anachronism” (Hess, 2006, p.5).

The literature on educational change offers numerous reasons why change initiatives are difficult (Shields & Oberg, 2009). According to Shields and Oberg, school calendars have been historically tied to the traditional school calendar and are typically dominated by social, political, and cultural realities that make it extremely difficult to convince people to consider an alternative school calendar.

Recommendations

The following recommendations are suggested for consideration based upon the observations and findings of this study:

1. This Midwestern state has offered districts that would like to consider the transition to the balanced school calendar financial support to help transition to the alternative calendar to improve student achievement. This practice should be continued for the next fiscal year. The results of this study give support to funding all interested schools regardless of at-risk population.
2. For school districts struggling to meet the learning targets set forth by state accountability measures, the balanced school calendar should be considered as a structural change to minimize the losses that occur annually as a result of an extended summer recess.
3. In light of the reported results, this study should be replicated in other districts, as the sample size was relatively small.
4. Despite the confounding research supporting the benefits of the balanced school calendar for at-risk students, future investigations into mathematical computation skills is recommended as the results of this study did not find statistical significance with this population.
5. Due to the fact that the results of this research are not generalizable to a similar population, more research is needed to validate the results of this study. A test of generalizability would be to determine additional studies would yield similar results.
6. This study was specific to the impact summer recess has on the learning retention of mathematical computation skills. Although previous research has identified that summer recess has the greatest impact on mathematics, Hattie (2009) determined that summer

recess has a negative impact on all students. As a result, testing other subject matter should be considered.

7. This study has acknowledged the top five performing countries on the TIMSS report. Of the top performing countries, all scored higher on the international mathematics test than American fourth graders. The number of days a student receives direct instruction could be relevant to a better understanding of the benefits of a modified or alternate calendar. An analysis of the number of school days a child attends, the type of school calendar, and the results of the TIMSS test warrant further study.

Future Inquiry

Although this study yielded data to support the fact that summer recess has a significant impact on student achievement, other research articles could be initiated based on the data collected. For example, prior to taking the post-test, students completed a short seven-question survey. The intent of the survey for this study was to determine whether or not a student received remediation or enrichment over the summer. To study self efficacy in regards to mathematical skills, the results from survey question number one, *I like math* and survey question number seven, *I am good at math*, could be analyzed as comparison to actual scores. Self-efficacy is the confidence or belief that we have in our own abilities that we can make something happen (Hattie, 2012). Important to the overall findings of this study is a need to better understanding the impact that self-efficacy had on the results of this study.

Based on this study, future research is needed to further explore the relationship between the at-risk status of a student and mathematical learning retention over summer recess. In addition, future researchers should consider replicating this study using other academic subjects.

Although previous research by Kneese and Knight (1995) has identified that summer recess as most detrimental on mathematical computation skills, follow-up studies are warranted. Additional research is also necessary to better understand the impact of academic enrichment and intervention programs being used at the elementary level.

Summary

School officials across the nation have been seeking ways to minimize the impact that summer recess has on student achievement. Administrators should consider a modified balanced calendar, which is being used by the top performing countries in mathematics on the TIMSS report. With the effect size of -0.09, summer recess has been proven to have a negative impact on student achievement (Hattie, 2009). For this study, criterion was used to match a pair of schools from one Midwestern school district. The selected schools were similar in many ways. The selected schools had similar percentage of enrolled students on the free and reduced lunch program and similar achievement levels based on the state education assessment program test.

The purpose of this empirical study was to investigate the relationship between the length of summer recess and mathematical learning retention. The focus was to examine the impact of the mathematical learning retention that occurs as a result of summer recess on second and third grade student in mathematics achievement in a Midwestern state. The study was conducted in one suburban school district. Half of the participants attended school on the traditional school calendar with a 12-week summer recess and the other half of the sample attended school on a balanced school calendar with a six-week summer recess.

Data were collected over two periods of time. Children were pre-tested using the M-COMP benchmark assessment the last week of school and post-tested again using the same test following summer recess the first week of school.

Several cognitive factors influenced the selection of the participants. First, executive attention is described as one of the common elements of the working memory and attention combining to predict cognitive tasks (McCabe et al., 2010). As a result, executive attention is linked to mathematical knowledge and fluency (LeFevre et al., 2013). Both knowledge and fluency are assumed to be mathematical skills that are secure by the end of second grade. Executive attention has been linked to numerous academic studies (Swanson & Beebe-Frankenberger, 2004). Mathematical performance is strongly linked with executive attention (Henry & MacLean, 2003). Ultimately, the selected benchmark assessment best met the potential to help answer the research questions.

Children are motivated to succeed. By integrating several theories, executive attention, encompasses achievement, self-determination, and the influence to succeed.

The data yielded impressive results. First, the length of summer recess makes a difference for all children. With a significance level of $p<0.000$, children who attended the balanced school calendar outperformed their counterparts from the traditional school calendar. Children who received either remediation or enrichment over the summer also outperformed their counterparts and the results of a multiple regression demonstrated a significance level of $p<0.000$.

It has been determined that the length of summer has a significant impact on mathematical retention for all children in the study. It can be assumed that the students attending the balanced school calendar retained more computational skills than their counterparts on the traditional school calendar. It can also be assumed that when children receive some math instruction in the summer, performance improves.

It appears that the data failed to support that at-risk students benefit from a shorter summer as compared to their middle and upper class peers, however, this study did not control for intervention and enrichment programs being used in schools, therefore further inquiry is needed to measure the impact of summer recess and at-risk status. In addition, gender did not yield any statistical significance.

While intending to be comprehensive in nature, several discussion points, recommendations, and future studies have been identified. Although educational change is often met with resistance, moving four-six weeks of the current summer vacation into the school year would enhance the academic achievement of all children, according to this study. Reducing the amount of academic loss annually as a result of summer recess could provide up to 1.5 years of increased academic retention of knowledge by the time a student enters high school. As a result, students entering high school would be better prepared and likely be more successful if they attended a balanced school calendar in the primary grades. This academic success could translate into more students being prepared for college, thus increasing the number of educated citizens. Educational stakeholders should use this study to make a case for change to the balanced school calendar. It is clear, the results of this study demonstrated that children who received instruction while attending school on a balanced school calendar retain more mathematical knowledge than their counterparts who attended school on the traditional calendar. Summer instruction also makes a difference. In the end, the balanced school calendar is good for all children regardless of economic status and gender. This study confirms what balanced school calendar supporters know; the calendar has a positive influence on mathematical achievement levels. This research re-energizes the balanced calendar debate and provides additional empirical evidence for educational leaders to use when considering a calendar change.

APPENDICES

APPENDIX A

4TH GRADE TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY (TIMSS)

Country	Number of Instructional Days	Type of Calendar	TIMMS 4th grade Math Average Score
Singapore	200	Balanced	606
Republic of Korea	220	Balanced	605
Hong Kong	195	Balanced	602
Chinese Taipei (Taiwan)	190	Balanced	591
Japan	243	Balanced	585
United States	180	Traditional	541

Note. Ministry of Education: Republic of China Taipei, Education Bureau of Hong Kong, Ministry of Education, Culture, Sports, Science, and Technology-Japan, Ministry of Education: Republic of Korea, Ministry of Education: Singapore, U.S. Department of Education.

APPENDIX B

POST-TEST SURVEY

Name: ____________________________

Post-test Survey

To better understand how you spent your summer vacation, please answer the following survey:

1) I like math. True/False

2) I spent the days in summer childcare. True/False

3) I stayed home with a family member this summer. True/False

4) During summer vacation, I spent some time at a math, space, or engineering camp. True/False

5) During my vacation, I participated in correspondence programs such as Grand Rapids Academic Summer Program (GRASP) or any other mail in math program. True/False

6) During my vacation, I spent time on the computer playing games like Xtra Math, Study Island Math, or any other online math game. True/False

7) I am good at math. True/False

APPENDIX C

THE NUMBER OF DAYS STUDENTS ATTEND SCHOOL IN COUNTRIES THROUGHOUT THE WORLD

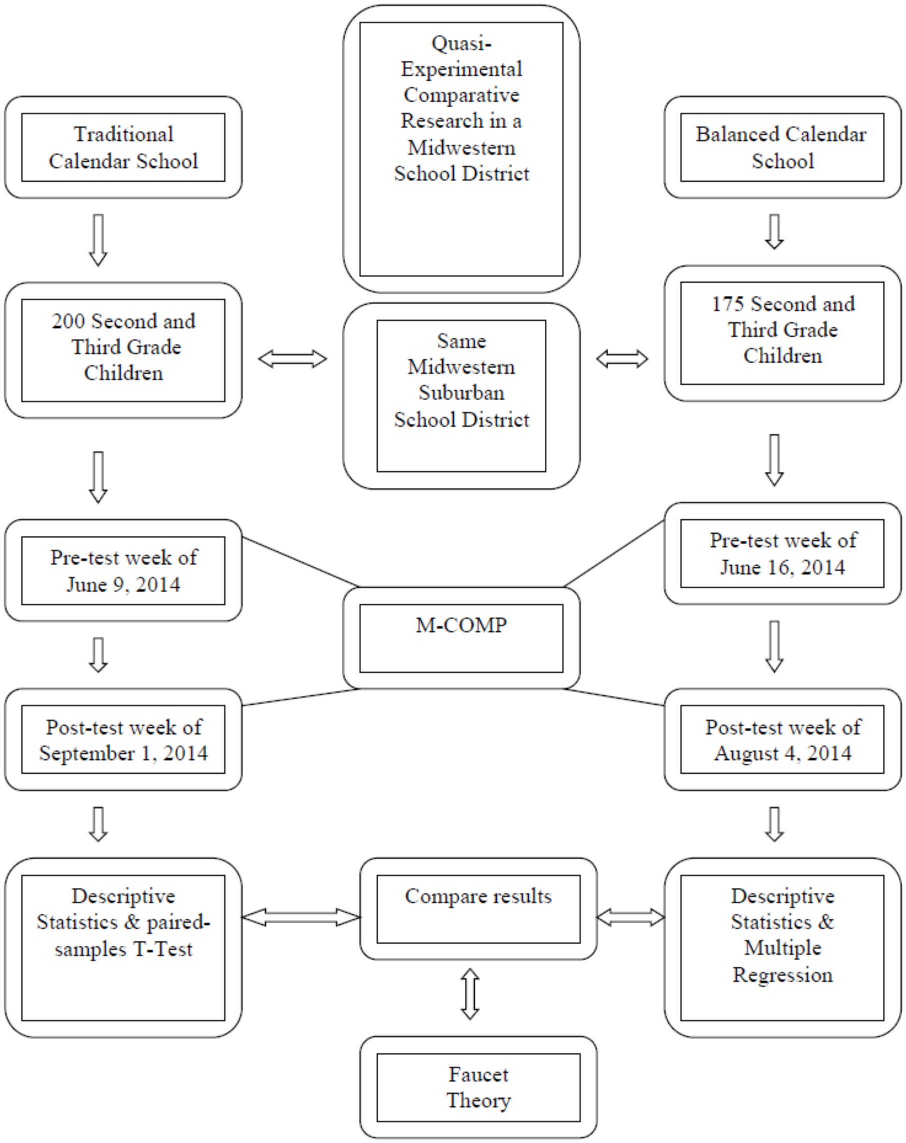
Country	Days in School
Japan	243
South Korea	220
Israel	216
Luxembourg	216
The Netherlands	200
Scotland	200
Thailand	200
Hong Kong	195
England	192
Hungary	192
Swaziland	191
Finland	190
New Zealand	190
Nigeria	190
France	185
United States	180

(Smithing & Swain, 2011)

Appendix C describes the number of days students attend school in countries throughout the world. By adding 30 days of intersession, students that attend school on the balanced school calendar and attend intersession classes would advance to the top third of days attended by students throughout the world.

APPENDIX D

FRAMEWORK



APPENDIX E

TRADITIONAL SCHOOL CALENDAR – NORTH SCHOOL

September

S	M	T	W	T	F	S
1	2	F	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	N	N	N	30

December

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	N	N	N	N	N	28
29	N	N				

January

S	M	T	W	T	F	S
			N	N	N	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	N	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	N	14
15	N	18	19	20	21	22
23	24	25	26	27	28	

March

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April

S	M	T	W	T	F	S
		1	2	3	N	5
6	N	N	N	N	N	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

May

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	N	27	28	29	30	31

June

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	L	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

BALANCED SCHOOL CALENDAR – SOUTH SCHOOL

August

S	M	T	W	T	F	S
				1	2	3
4	5	F	7	8	9	10
11	12	13	14	15	N	17
18	19	20	21	22	23	24
25	26	27	N	N	N	31

September

S	M	T	W	T	F	S
1	N	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	N	N	N	N	N	28
29	30					

October

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	N	N	N	N	N	30

December

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	N	N	N	N	N	28
29	N	N				

January

S	M	T	W	T	F	S
			N	N	N	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	N	21	22	23	24	25
26	27	28	29	30	31	

February

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	N	N	N	N	N	22
23	N	N	N	N	N	

March

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April

S	M	T	W	T	F	S
		1	2	3	N	5
6	N	N	N	N	N	12
13	N	N	N	N	N	19
20	21	22	23	24	25	26
27	28	29	30			

May

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	N	N	N	N	N	31

June

S	M	T	W	T	F	S
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8	9	10	11	12	13	14
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REFERENCES

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Directions in Psychological Science, 11*(5), 181-185.

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin & Review, 14*(2), 243-248.

Bainbridge, W. L. (2005). U.S. students need longer school year. In C. E. Ballinger & C. Kneese, (Eds.), *Balancing the school calendar: Perspectives from the public and stakeholders* (pp. 11-12). Lanham, MD: Rowman & Littlefield.

Ballinger, C. E. (1995). Prisoners no more. *Educational Leadership, 53*(3), 28-31.

Ballinger, C. E., Kirschenbaum, N., & Poinbeauf, R. P. (1987). The year-round school: Where learning never stops. *Phi Delta Kappa*, 16-24.

Ballinger, C. E., & Kneese, C. (2009). *Balancing the school calendar: Perspectives from the public and stakeholders*. Lanham, MD: Rowman & Littlefield.

Ballinger, C. E., & Kneese, C. (2006). *School calendar reform: Learning in all seasons.* Lanham, MD: Rowman & Littlefield.

Barrett, J. F., Tugade, M. M., & Engle, R. W. (2004). Individual differences in working memory capacity and dual-process theories of the mind. *Psychological Bulletin, 130*(4), 553-573.

Barrett, M. J. (1990, November). The case for more school days. *The Atlantic Monthly*, *266*(5), 78-106.

Barrouillet, P., & Lepine, R. (2005) Working memory and children's use of retrieval to solve addition problems. *Journal of Experimental Child Psychology, 91*(3), 183-204.

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development, 81*, 1641-1660.

Borman, G. D., Benson, J., & Overman, L. T. (2005). Families, schools, and summer learning. *The University of Chicago Press, 106*(2), 131-150.

Bracey, G. W. (1994). Sex and math, revisited. *Phi Delta Kappan, 75*(5), 417.

Bray, S., & Roellke, C. (1998). The evidence on year-round education. *Kappa Delta Pi Record, 15*(4), 84-88.

Cammarata, G. (1961). Summer programs for students and teachers. *Education Digest*, *27*, 26-28.

Cooper, H., Charlton, K., Valentine, J. C., & Muhlenbruck, L. (2000). Making the most of summer school: A meta-analytic and narrative review. *Monographs of the Society for Research in Child Development*, *65*(260), 1-118.

Cooper, H. (2003). Summer learning loss: The problem and some solutions. Retrieved February 24, 2014, from http://www.ericdigests.org/2003-5/summer.htm

Cooper, H., Nye, B., Charlton, K., Lindsay, J., & Greathouse, S. (1996). The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. *Review of Educational Research, 66*(3), 227-268.

Cramer, P. (2006). Our poll results: Extended day upsets schedule. Retrieved April 17, 2014 from: www.insideschools.org/contact-us/itemlist/category

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

Davies, B., & Kerry, T. (1999). Improving student learning through a calendar change. *School Leadership and Management, 19*(3), 56.

Davis, J. (2006, February). The promise of extending-time schools for closing the achievement gap. Address given to the *National Association of Year-Round Education*, Boston, MA.

Dereshiwsky, M. (1999). *Limitations and delimitations*. Online reading. Retrieved from http://jan.ucc.nau.edu/~mid/edr720/class/methodology/delimitations/reading3-3-1.html

Dowker, A., Bennett, K., & Smith, L. (2012). Attitudes to mathematics in primary school children. *Child Development Research*. http://dx.doi.org/10.1155/2012/124939

Dwyer, L. (2011, May). How do we prepare kids for jobs we can't imagine yet? *Teach Imagination*. Retrieved from http://magazine.good.is/articles/how-do-we-prepare-kids-for-jobs-we-can-t-imagine-yet-teach-imagination

Education Bureau of Hong Kong. (2014). Education System and Policy. (26, September, 2014). Retrieved from http://www.edb.gov.hk/en/edu-system/list-page.html

Elliott, L. H. (2002, February, 13). Restructuring American education. *Education Week, 21*(22). 46.

Entwisle, D. R., Alexander, K. L., & Olson, L. S. (2001). Keep the faucet flowing: Summer learning and home environment. *American Educator, 25*(3), 10-15.

Entwisle, D. R., Alexander, K. L., & Olson, L. S. (1997). *Children, schools, and inequality*. Boulder, CO: Westview.

Entwisle, D. R., & Alexander, K. L. (1992). Summer setback: Race, poverty, school composition, and mathematics in the first two years of school. *American Sociological Review, 57*(1), 72-84.

ESEA Flexibility. (2012). *Elementary and Secondary Education Act Flexibility Request*. Washington, D.C.: U.S. Department of Education.

Fairchild, R., & Boulay, M. (2002, November). *What if summer learning loss were an education policy priority?* Paper presented to the 24th Annual APPAM Research Conference on. Baltimore, MD. Retrieved February 25, 2014 from http://www.whatkidscando.org/whatslearned/WhatifSummerLearning.pdf

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14*(3), 340-347.

Ferguson, J. M. (1999). The effect of year-round school on student achievement in mathematics. *The Educational Forum, 64*(1), 82-87.

Fischel, W. A. (2006). Will I see you in September? An economic explanation for the summer school vacation. *Journal of Urban Economics, 59(*2), 236-251.

Fischel, W. A., Hale, P. F., & Hale, W. B. (2003). Will I see you in September? An economic explanation for the summer school vacation. Retrieved February 24, 2014, from www.dartmouth.edu/~wfischel/

Food and Nutrition Services; 77 Fed. Reg. 17004 (March 23, 2012). Retrieved February 25, 2014, from www.federalregister.gov/citation/60/17004

Ganley, C. M., & Vasilyeva, M. (2011). Sex differences in the relation between math performance, special skills, and attitudes. *Journal of Applied Developmental Psychology, 32*(4), 235-242.

Gay, L. R., Mills, G. E., & Airasian, P. W. (2011). *Educational research: Competencies for analysis and applications* (10th ed.). Boston, MA: Pearson.

Gershenson, S. (2013). Do summer time-use gaps vary by socioeconomic status? *American Educational Research Journal, 50*(6), 1219-1248.

Gilson, L. L., Mathieu, J. E., Shalley, C. E., & Ruddy, T. M. (2005). Creativity and standardization: Complementary or conflicting drivers of team effectiveness? *Academy of Management, 48*(3), 521-531.

Glines, D. (2009). Grounding calendar change: A call for reimagining continuous learning. In C. E. Ballinger & C. Kneese (Eds.), *Balancing the school calendar: Perspectives from the public and stakeholders* (pp. 131-148). Lanham, MD: Rowman & Littlefield.

Glines, D., & Bingle, J. (2002). *National association for year-round education: A historical perspective*. San Diego, CA: NAYRE.

Glines, D. (1995). *Year-round education: History, philosophy, future.* San Diego, CA: NAYRE.

Goertz, M. (2007). *Standards-based reform: Lessons from the past, directions for the future.* Brown University. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.184.3306&rep=rep1&type=pdf

Gordon, A. (2011). Summer slide. *Library Media Connection, 29*(6), 22.

Haeberlin, B. (2002). Improving student achievement by balancing the school calendar. *Catalyst for Change, 32*(1), 10-12.

Hamilton, J., Johnston, S., Marshall, J., & Shields, C. (2006). Schools that like making the most of time. *Educational Leadership*. *63*(8), 72-73.

Haser, S. G. (2009). The modified calendar: Benefits for teachers. In C. E. Ballinger & C.

Kneese (Eds.), Balancing the school calendar; Perspectives from the public and stakeholders (pp 44-51). Lanham, MD: Rowman & Littlefield.

Haser, S., & Nasser. I. (2005). *Year-round education: Change and choice for schools and teachers*. Lanham, MD: Rowman & Littlefield.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta analyses relating to achievement*. New York, NY: Routledge.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning.* New York, NY: Routledge.

Hayes, D. P., & Grether, J. (1983). The school year and vacations: When do students learn? *Cornell Journal of Social Relations, 17*(1), 56-71.

Hecht, S. A. (2002). Counting on working memory in simple arithmetic when counting is used for problem solving. *Memory & Cognition, 30*(3), 447-455.

Henry, L., & MacLean, M. (2003). Relationship between working memory, expressive vocabulary and arithmetical reasoning in children with and without intellectual disabilities. *Educational and Child Psychology, 20*(3), 51-63.

Hermansen, K., & Gove, J. R. (1971). *The year-round school*. Hamden, CT: Linnet.

Hess, F. M. (2006). Summer vacation of our discontent. In C. E. Ballinger & C. Kneese (Eds.), *Balancing the school calendar: Perspecitves from the public and stakeholders* (pp. 3-10). Lanham, MD: Rowman & Littlefield.

Johnson, J. (2000). Teaching and learning mathematics: Using research to shift from the "yesterday" mind to the "tomorrow" mind. Retrieved April 22, 2014 from www.k12.wa.us

Kane, M. J., Conway, A. R. A., Hambrick, D. Z., & Engle, R. W. (2007). Variation in working memory capacity as variation in executive attention and control. In A. R. A. Conway. *Variation in working memory*. Oxford, UK: Oxford University Press.

Kneese, C. C. (2000). *Teaching in year-round schools*. Washington, DC: Clearinghouse on Teaching and Teacher Education.

Kneese, C. C., & Knight, S. (1995). Evaluating the achievement of at-risk students in year-round education. *Planning and Changing*, *26*, 1-19.

Lane, E. N. (1932). The all-year school: Its origins and development. *Nation's Schools, 9*, 49-52.

LeFevre, J. A., Berrigan, L, Vendetti, C., Kamawar, D., Bisanz, J., Skwarchuk, S. L., & Smith-Chant, B. L. (2013). The role of executive attention in the acquisition of mathematical skills for children in grades 2 through 4. *Journal of Experimental Child Psychology*, *114*(2), 243-261.

Lundstrom, M. (2005). Stop the summer reading slide. *Instructor*, *114*(8), 20-26.

Lussier, R. N., & Achua, C. F. (2007). *Leadership: Theory application, skill development* (3rd ed.) Mason, OH: Thomson South-Western.

MASA. (2014). Michigan Association of School Administrators. *Governor signs school aid bill with year-round school grants*. (27, May, 2014) Retrieved from http://cqrcengage.com/masb/app/document/2242414

Maher, R. (2001, January). Let's not forget the children. *Principal Leadership*, *1*(5), 5-7.

Mattingly, J. W. (2007). *A study of relationships of school climate, school culture, teacher efficacy, collective efficacy, teacher job satisfaction, and intent to turnover in the context of year round education calendars.* (Unpublished doctoral dissertation). University of Louisville, Louisville, KY.

McCabe, D. P., Roediger, H. L., McDaniel, M.A., Baloa, D.A., & Hambrick, D. Z. (2010). The relationship between working memory capacity and executive functioning: Evidence for a common executive attention construct. *Neuropsychology*, *24*(2), 222-243.

McClelland, D. C. (1961). *The achieving society.* New York, NY: The Free Press.

McCombs, J. S., Augustine, C. H., Schwartz, H. L., Bodilly, S. J., Mcinnis, B., Lichter, D. S., & Cross, A. B. (2011). *Making summer count: How summer programs can boost children's learning*. Santa Monica, CA: RAND.

MDE. (2014a) Michigan Department of Education. (2014, March 27). *School calendars*. Retrieved from http://www.michigan.gov/documents/mde/waiver_labor_day_1-23-08_224652_7.pdf

MDE. (2014b) Michigan Department of Education. (2014, March 27). *MEAP*. Retrieved from http://www.michigan.gov/mde/0,1607,7-140-22709_31168---,00.html

Meyer, M. L., Salimpoor, V. N., Wu, S. S., Geary, D. C., & Mennon, V. (2010). Differential contribution of specific working memory components to mathematics achievement in 2nd and 3rd graders. *Learning and Individual Differences*, *20*(2), 101-109.

Miller, B. M. (2007). *The learning season: The untapped power of summer to advance student achievement*. Quincy, MA: Nellie Mae Education Foundation.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of precortex function. *Annual Review of Neuroscience*, *24*, 167-202.

Ministry of Education, Culture, Sports, Science, and Technology-Japan. (2014). Guide for foreign students to start school. (26, September, 2014). Retrieved from http://www.mext.go.jp/english/elsec/1303764.htm

Ministry of Education Republic of China (Taiwan). (2014). Useful Information. (26, September, 2014). Retrieved from http://english.moe.gov.tw/lp.asp?CtNode=11446&CtUnit=1351&BaseDSD=16&mp=1

Ministry of Education Republic of Korea. (2014). Educational Statistics. (26, September, 2014). Retrieved from http://english.moe.go.kr/web/1721/site/contents/en/en_0219.jsp

Ministry of Education Singapore. (2014). School terms and holidays. (26, September, 2014). Retrieved from http://www.moe.gov.sg/schools/terms-and-holidays/#

Mitchell, C. & Begeny, J. C. (2014). Improving student reading through parents' implementation of a structured reading program. *School Psychology Review*, *43*(1), 41-58.

Moore, L. L., Grabsch, D. K., & Rotter, C. (2010). Using achievement motivation theory to explain student participation in a residential leadership learning community. *Journal of Leadership Education*, *9*(2), 22-34.

Morse, S. C. (1992). The value of remembering. *Thrust for Educational Leadership*, *21*(6), 35-37.

Muijs. D. (2011). *Doing quantitative research in education with SPSS* (2nd ed.). Thousand Oaks, CA: SAGE.

Naylor, C. (1996, January). *Year-round education: Is it worth the hassle?* Paper presented at the University of British Columbia Robson Square Lecture Series, Vancouver, British Columbia.

NAYRE. (2009). *The National Association for Year-Round Education*. Retrieved February 25, 2014, from http://www.nayre.org

No Child Left Behind (NCLB) Act of 2001, Pub. L. No. 107-110, § 115, Stat. 1425 (2002).

NEC. (2005). National Education Commission on Time and Learning. *Prisoners of time*. Washington, DC. U.S. Government Printing Office. Retrieved, February 25, 2014 from http://ed.gov/pubs/Prisoners

National Center on Intensive Instruction. (n.d.). Retrieved March 20, 2014 from http://www.intensiveintervention.org.progress-monitoring/aimsweb-math-computation-0

NCRTI. (2009). *National Center on Response to Intervention*. Retrieved March 30, 2014, from http://www.prweb.com/printer/2556504.htm

Noltemeyer, A., Bush, K., Patton, J., & Bergen, D. (2012). The relationship among deficiency needs and growth needs: An empirical investigation of Maslow's theory. *Children and Youth Services Review*, *34*(9), 1862-1867.

Paine, S. L., & Schleicher, A. (2011). What the U.S. can learn from the world's most successful education reform efforts. Retrieved from http://www.mcgraw-hillresearchfoundation.org/wp-content/uploads/pisa-intl-competitiveness.pdf

Pallant, J. (2013). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS.* (5th ed.). New York, NY: Open University Press.

Pearson Inc. (n.d.). Retrieved March 20, 2014 from http://www.cnyric.org/tfiles/folder1052/M-COMP%20Administration%20and%20Scoring%20Guide.pdf

Pepper, S. (2009). Multitracking in school calendar reform. In C. E. Ballinger & C. Kneese (Eds.), *Balancing the school calendar: Perspectives from the public and stakeholders* (pp. 117-130). Lanham, MD: Rowman & Littlefield.

Provasnik, S. (2012). Highlights from TIMSS 2011: Mathematics and science achievement of United States fourth and eighth-grade students in an international context. *National Center for Educational Statistics*. Washington, DC.

Raghubar, K. P., Barnes, M. A., & Hecht, S. A. (2010). Working memory and mathematics: A review of developmental, individual difference, and cognitive approaches. *Learning and Individual Differences, 20*, 110-122.

Rakoff, T. D. (1999, April). *Schooltime.* Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Raywid, M. (1992). Choice orientations, discussions, and prospects. *Educational Policy, 6*(2), 105-122.

Roberts, C. M. (2004). *The dissertation journey: A practical and comprehensive guide to planning, writing, and defending your dissertation*. Thousand Oaks, CA: Corwin.

Rotman, D. (2013, June). How technology is destroying jobs. MIT Technology Review. Retrieved June 2, 2014 from http://www.technologyreview.com/featuredstory/515926/how-technology-is-destroying-jobs/

Rozelle, J. J., & Makenzie, A. H. (2011) Biology experiences in the summer: Keeping the faucet flowing for all students. *The American Biology Teacher, 73*(8), 449-452.

Rubin, D. I., & Kazanjian, C. J. (2011). Just another brick in the wall: Standardization and the devaluing of education. *Journal of Curriculum and Instruction, 5*(2), 94-108.

Ruggiero, A. (2008). *At issue: Year-round schools*. Farmington Hills, MI: Greenhaven Press.

Rury, J. L. (2013). *Education and social change: Contours in the history of American schooling.* (4th ed.). New York, NY: Routledge.

Schuler, J., Sheldon, K. M., & Frohlich, S. M. (2010). Implicit need for achievement moderates the relationship between competence need satisfaction and subsequent motivation. *Journal of Research in Personality*, 44, 1-12.

Schulte, B. (2009). Putting the brakes on summer slide: Modified school calendars build in time to enrich learning and sustain gains. *Educational Digest, 75*(4), 17-22.

Shields, C., & Oberg, S. (2009). Balanced calendar schools: Combining structural change and transformational leadership. In C. E. Ballinger & C. Kneese (Eds.), *Balancing the school calendar: Perspectives from the public and stakeholders* (pp. 19-43). Lanham, MD: Rowman & Littlefield.

Shields, C., & Oberg, S. (1999). *Year-round schooling: Promises and pitfalls*. London, UK: Scarecrow.

Silva, E. (2007). On the clock: Rethinking the way schools use time. *Education Sector Reports*, 1-9.

Smith, L (2012). Slowing the summer slide. *Educational Leadership, 69*(4), 60-63.

Smith, M., & Brewer, D. (2007). *Stop summer academic loss: An education policy priority*. Durham, NC: MetaMetrics, Inc.

Smithling, C. F., & Swain, C. (2011). *Should school be year-round?* New Rochelle, NY: Benchmark Education.

Snyder, R. (2014, January)"State of the State Address." Lansing, MI. Address given to the State of Michigan.

Steiner, J. (2000). Implications of a standards-based curriculum for teaching-learning assessment processes. *English Teachers' Journal, 53*, 9-14.

Stenvall, M. J. (2002). A decade of change: Who says it's the same old school? *Catalyst for Change, 32*(1), 6-7.

Sternberg, R. J. (2009). *Cognitive Psychology*. (5th ed.).Belmont, CA: Wadsworth.

Swanson, L. H., & Beebe-Frankenberger, M. (2004). The relationship between working memory and mathematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology, 96*(3), 471-491.

Talbot, M. (2000, July, 30). The way we live now: School's out for never. NY TIMES. Retrieved from http://www.nytimes.com/2000/07/30/magazine/the-way-we-live-now-7-30-00-school-s-out-for-never.html

Tronsky, L. N. (2005). Strategy use, the development of automaticity, and working memory involvement in complex multiplication. *Memory & Cognition*, *33*(5), 927-940.

Usher, A. (2012). *AYP results for 2010-11-May 2012 update*. Center on Education Policy.
U.S. Department of Education (2014). Data and Research. (26, September 2014). Retrieved from http://www2.ed.gov/rschstat/landing.jhtml?src=pn

U.S. Department of Education. (2010). *A blueprint for reform: The reauthorization of the Elementary and Secondary Education Act*. Washington, DC: U.S. Department of Education.

Varol, F., & Farran, D. (2007). Elementary school students' mental computation proficiencies. *Early Childhood Education Journal*, *35*(1), 89-94.

Weiss, J., & Brown, R. S. (2005). Summer learning: Research, policies, and programs. *Teachers College Record, 107*(7), 1429.

Will, M. (2014, October 8). Popularity grows anew for year-round schooling. *Education Week, 34*(7), 6.

Wilmore, C., & Slate, J. (2012). Texas elementary school academic achievement as a function of school calendar type. *Journal of Education Policy, Planning, and Administration, 2*(1), 24-38.

Wu, S. S., Meyer, M. L., & Maeda, U. (2008). Standardized assessment of strategy use and working memory in early standardized assessment of strategy use and working memory in early mental arithmetic performance. *Developmental Neuropsychology*, *33*, 365-393.

Zvoch, K. & Stevens, J. J. (2013). Summer school effects in a randomized field trial. *Early Childhood Quarterly, 28*(1), 24-32.