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Effects of Summer School on Academic Achievement: Reducing Summer Learning Loss in Middle School

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Abstract

Summer learning loss has been implicated in the achievement gap between economically advantaged and disadvantaged students. The purpose of this study is to examine the effects of a summer school program on the degree of summer learning loss and academic achievement of middle school students. Participants included a census of middle school students who attended the summer school program at a small public charter school in the Midwest between the fall of 2010 and the spring of 2014. Achievement and learning loss were determined based on fall and spring testing using the Northwest Evaluation Association's Measures for Academic Progress test, a non-grade-leveled, computerized adaptive test. Data was gathered for the school year prior to summer school attendance as well as the school year following attendance. National normative data on the MAP test for the same grade levels was used as a comparison measure. Two-sampled t-test analyses and comparisons to normative data indicated significant summer learning in mathematics for students attending between their 6th and 7th grade year, and significant post-treatment achievement gains for students attending between their 7th and 8th grade year. Gains for reading and language usage were not significantly different than expected norms during the summer or the post-treatment year. Implications for summer school and future study are given.

Keywords: Academic Achievement, Achievement Gap, Charter Schools, Summer Schools, Adaptive Testing, Middle School Students, Summer Programs

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Chapter One: Introduction

Problem Statement

Many students lose academic ground over the long summer vacation. This phenomenon is often called summer learning loss: when students forget previously learned material over the months when school is not in session (Entwisle, Alexander, & Olson, 1998). When these students return to school in the fall, teachers often must spend class time reviewing previously learned material before getting into new subject matter. Research on summer learning loss has found it to be a major contributor to the academic achievement gap between higher socioeconomic status and lower socioeconomic status students (Alexander, Entwisle, & Olson, 2007a). It has been shown that these students show similar gains in achievement during the school year, but during the summer months, when schools are not influencing learning, low socioeconomic families and communities often cannot provide the same access to learning opportunities as higher socioeconomic ones, and these students experience greater levels of learning loss, adding to the achievement gap each summer. (Alexander, Entwisle, & Olson, 2007a; Entwisle, Alexander, & Olson, 1998). To help bridge this gap, schools and communities have implemented various strategies for reducing summer learning loss including summer reading programs (Kim & Quinn, 2013; Roman & Fiore, 2010) and summer school programs (Borman, Benson, & Overman, 2005; Green, et al., 2011). These strategies have found varying degrees of success; however, much of the literature has focused either on early elementary interventions or on high school interventions. Little attention has been paid to the efficacy of middle school programs.

Importance of the Problem and Rationale for the Study

Research by Alexander, Entwisle, and Olson (2007a) has shown that economically disadvantaged elementary students consistently experience learning losses over the long summer vacation away from school while middle and upper income students do not experience this and often show learning increases over the summers (also found by Wintre, 1986). During the school year, all students improve their learning at about the same rate, but disadvantaged students fall further behind their peers each summer. In the long run, this disparity in summer learning leads to a sizable achievement gap along economic lines.

If this gap cannot be lessened during the school years, students from disadvantaged backgrounds will not have the same opportunities for a bright future as their more advantaged peers. Students from lower socioeconomic status families tend to have higher drop-out rates than their peers and lower college attendance as well (Alexander, Entwisle, & Olson, 2007b). This makes it much more difficult for them to climb out of the lower socioeconomic rungs of society, allowing the cycle to repeat for the next generation.

Since the enactment of No Child Left Behind legislation (2001), schools have been graded on the yearly academic progress of their students. What this legislation does not take into account is the amount of learning (or lack of learning) that takes place outside of the school setting, particularly during the summer months. Downey, von Hippel, and Hughes (2008) evaluated schools only on the academic progress of students during the school year, rather than over a full year (including the summer), and found that the schools that would be deemed ‘failing’ changed dramatically. Schools serving disadvantaged areas were not doing as badly as originally thought, where some schools serving more privileged populations were not doing as well. It seems unfair to grade the effectiveness of schools based partly on the learning or lack of learning that takes place when schools are not even in session.

Background of the Problem

The current push for evaluating schools based on student academic achievement brought about by the No Child Left Behind Act of 2001 and Race to the Top initiative of 2009 (U.S. Department of Education, 2009), has held schools accountable for student learning. Unfortunately, current evaluation methods do not differentiate between learning that takes place during the school year and learning, or learning loss, that takes place during the summer months when school is not in session (Downey, von Hippel, & Hughes, 2008).

Many studies have shown that students from all backgrounds learn at about the same rate during the months when school is in session, but that students from economically disadvantaged backgrounds fall behind their more advantaged peers during the months when school is out for the summer (Alexander, Entwisle, & Olson, 2007a; Downey, von Hippel, & Broh, 2004). Consequently, many have called for an extension of the school year or school year activities for these student populations to prevent the widening of the achievement gap (Alexander, Entwisle, & Olson, 2007a; Kerry, & Davies, 1998; Southern Regional Education Board, 2002).

Some schools and public libraries have implemented summer reading programs to increase the amount of time students spend reading during the summer months. Kim (2004) found that the more books elementary students read over the summer months, the higher their fall reading score, regardless of their pre-test scores in reading and writing. Reading even one book during the summer seemed to produce an effect. Even voluntary summer reading programs can produce reading gains for elementary students who participate (Roman & Fiore, 2010), but those students from low socioeconomic backgrounds are more likely to participate in and benefit from a more organized, targeted summer reading program (White, Kim, Kingston, & Foster, 2013).

Another alternative for low achieving students that has shown promise is the implementation of a curriculum-focused summer school program. The Southern Regional Education Board (SREB) report *Summer School: Unfulfilled Promise* (2002), concluded that summer school can be an effective tool, if used properly, to reduce the rates of failure, narrow the achievement gap, and reduce the need for schools to decide between grade retention and social promotion. Proponents of this option have stated many benefits, including decreasing the learning loss that may occur over the long summer vacation (Borman, Benson, & Overman, 2005; Green, et al., 2011; Zvoch & Stevens, 2013), providing concentrated remediation for at-risk students to improve skills that will enable them to be prepared for the following school year (Edmonds, O'Donoghue, Spano, & Algozzine, 2009), and providing enrichment opportunities for excelling students (Li, Alfeld, Kennedy, & Putallaz, 2009).

Many studies have shown academic gains for students attending summer programs designed for at-risk or academically challenged students. Zvoch and Stevens (2013) conducted one of the few experiments that employed random assignment of kindergarten and first grade subjects to treatment and control groups. The students invited to be part of the summer program could not be required to attend, but those who did attend showed significant improvements in literacy and reading fluency following the five-week treatment over control group peers as well as students who were invited but chose not to attend. Another elementary school study (Borman, Benson, & Overman, 2005) found that students who attended a summer school program showed significantly less summer learning loss as long as the parents were also dedicated to the program and promoted student attendance in the program.

Other research has shown little to no gains following summer school attendance. Zvoch (2011) found that struggling readers in first grade who participated in a summer literacy program showed gains greater than their peers at the start of the following school year but that their progress during the course of that school year was slower than their peers who did not participate in the summer program. In addition, a six-week pre-kindergarten summer literacy program which worked on some of the important pre-literacy skills needed in the primary grades found that attendees showed consistent improvements over their non-attending peers, but that only some of those improvements were statistically significant (Edmonds et al., 2009).

Much of the research into summer school programs has limited applicability. Very few studies employ experimental or even quasi-experimental designs. Those who have attempted an experimental design using random assignment have run into problems with relatively large percentages of non-attenders (Zvoch & Stevens, 2013). Many studies involve small sample sizes and studies are rarely longitudinal in design. All of these severely limit the generalizability of the studies to any larger population.

Also, much of the research into the efficacy of summer programs for improving achievement has involved subjects either in lower elementary grades or in high school grades. Research into middle school summer programs has mainly focused on enrichment programs (for an example, see Li, Alfeld, Kennedy, & Putallaz, 2009) geared toward specific career or college paths rather than remediation of academic difficulties. This leaves a substantial gap in our understanding of the efficacy of summer school programs.

A public charter school, founded in western Michigan, is the focus of this study. It consists of slightly less than 900 students, in kindergarten through 12th grade, in a college preparatory program. The school was founded on a mission of high academic standards, experiential learning, and community involvement. The kindergarten and elementary programs are Montessori-based programs with multi-grade classrooms for lower elementary, 1st-3rd, and upper elementary, 4th-5th. The middle and high school courses (6th through 12th grades) are mainly housed within the same building and most secondary teachers are involved with classes in multiple grade levels. Community service hours are required for all grade levels and students must be accepted into a four year college or university in order to receive a high school diploma.

During the summer vacation months, the school offers a three to four week summer school program (schedules vary from year to year). The focus of the program consists of two main academic subjects: mathematics and English language arts (with blocks of time focused on reading and other blocks on writing), with some additional time spent in physical education activities. This program is open to all students, although it is not widely advertised, but students who have struggled academically or who have failed academic courses during the year are formally invited to attend during the summer. Students are typically invited based on the recommendations of their teachers. Invited students, with the input of families, then decide whether or not to attend.

A variety of class schedules have been utilized by the summer school program. Some summers, courses ran four full-days per week. Other summers, courses have run five half-days per week. The program is designed to cover many of the main course objectives of the previous school year as well as some of the main objectives of the next school year in order to prepare students for some of the content they will see in the upcoming year and increase their chances for success. However, the summer program does not have a set of strict curriculum guidelines to follow and is often taught by different teachers, some teaching outside of their certified subject areas, so the content taught each summer may vary as well as the quality of the instruction given. Teachers of the summer school program, as well as the regular school year program, are encouraged to utilize hands-on, experiential learning whenever possible.

As a Grand Valley State University charter school, the school is required to administer the Northwest Evaluation Association's (NWEA's) Measures of Academic Progress test (MAP) to all students in both the fall and spring of grades three through eight. The MAP test is a computerized adaptive test, designed to measure academic progress in the areas of mathematics, language usage, and reading. As students respond correctly to questions, the program will present them with progressively more difficult questions. However, if students respond incorrectly to questions, the program will present a simpler question (Kingsbury & Hauser, 2004).

According to the Technical Manual for the Measures of Academic Progress and Measures of Academic Progress for Primary Grades (NWEA, 2011b), the MAP test has been shown to have good test-retest reliability (r values consistently in the high 0.7's to high 0.8's) as well as good predictive validity (r values in the 0.7's through 0.8's with various state exams) and concurrent validity (r values in mid 0.6's to low 0.8's for reading and high 0.6's to high 0.8's for math with various state exams). The school began administering this test in the fall of 2010.

Statement of Purpose

The purpose of this study is to evaluate the effectiveness of the summer school program at a small public charter school for reducing summer learning loss and improving overall academic achievement. This adds to current body of knowledge on the efficacy of summer school programs to reduce the achievement gap and summer learning loss, and addresses the gap in the current body of knowledge in regards to the efficacy of these programs for middle school students. Currently, research in this area has focused on elementary age or high school age students. The literature on summer programs for middle school students appears to focus on enrichment programs geared toward future career interests. The current study also seeks to determine whether the year of summer school attendance in middle school (between 6^{th} and 7^{th} grade, or between 7^{th} and 8^{th} grade) has an effect on the academic outcomes. Many studies have suggested that earlier interventions provide better outcomes than those later in schooling (Campbell & Ramey, 1994; O'Connor, Bocian, Sanchez, & Beach, 2014; Wu, West & Hughes, 2010). This study will also assist the administration and leadership at the school to determine whether additional courses of action should be designed, implemented, and tested to reduce summer learning loss and decrease the achievement gap for middle school students.

Research Questions

1. How does completion of the summer school program affect summer learning loss and academic achievement for middle school students as compared to national norms of learning loss and achievement?
2. How does the year of summer school attendance (attending between the 6^{th} and 7^{th} grade year versus attending between the 7^{th} and 8^{th} grade year) affect both summer learning loss and academic achievement?

Hypotheses

Middle school students who complete the summer school program will show greater overall academic achievement and less summer learning loss than the national normative data would predict for their grade level.

Middle school students who attend the summer school program between their 6th and 7th grade school years will show greater academic achievement and less summer learning loss than students who attend the program between their 7th and 8th grade years.

Design, Data Collection, and Analysis

Permission was obtained from the administration at the school to use student data for the purposes of the study. All data was collected in a way that would maintain confidentiality of student records. Demographic data for the treatment groups was compiled, in aggregate, by a school administrator. All testing data was compiled by school administrators as well, stripped of any identifying information, and coded, using numbers to represent individual students in the treatment groups. This raw data was entered into a spreadsheet and was later analyzed using SAS software.

The current study utilized a causal-comparative design using existing data, comparing existing groups. The population consisted of students who attended at least two years of middle school (pre- and post-treatment years during 6th through 8th grade) between the time of fall 2010 and spring 2014. The sample consisted of two categories of students who attended the summer school program at least one summer: one group attended between 6th and 7th grade (Group A, n=29), and the other group attended between 7th and 8th grade (Group B, n=31) during the years studied. Demographic data was obtained, in aggregate, on the subjects in the areas of gender, race, special education diagnosis, and socio-economic status (through free and reduced lunch participation).

Achievement data for all subjects was contained within school records and consisted of NWEA MAP test scores obtained for all students in the sample during the fall and spring of the school year prior to the treatment summer and fall and spring of the school year following the treatment summer. For each subtest of the MAP test, language usage, mathematics, and reading, three separate differences were calculated. First, pre-treatment academic growth was calculated using the difference between the spring (end of the school year) pre-treatment test score and the fall (beginning of the school year) pre-treatment test score (PREGAIN). Second, a value for summer learning (or learning loss when negative) was calculated using the difference between the fall post-treatment test score and spring pre-treatment test score (SUMMER). Third, post-treatment academic growth was calculated using the difference between the spring post-treatment test score and the fall post-treatment test score (POSTGAIN).

Two sample t-test analyses were conducted for group A and group B on all differences (PREGAIN, SUMMER, and POSTGAIN) for each subtest of the MAP test: language usage, reading, and mathematics. This allowed for the identification of significant gains or losses. Because student data was used for three separate within-subjects tests, α needed to be adjusted to correct for type 1 errors ($\alpha^* = \alpha/3$). This led to significance levels at $p \leq 0.016$. A 95% confidence interval of the mean was also calculated from these tests.

Comparison data was gathered from the NWEA Norms Study (NWEA, 2011a). The Norms Study used a large sample of student MAP test scores from 2009 and 2010, randomly selected from the national population of schools who take the test, to calculate RIT score norms for the beginning, middle, and end of the school year for each grade level on each subtest. Over 20,000 student scores went into each grade level norm. From this normative data, average growth for each grade level was calculated as the difference between the end-of-school-year score and beginning-of-school-year score for each grade level. Also, an average summer learning or summer learning loss was calculated with the difference between the beginning of one school year to the end of the previous school year (i.e. the beginning of 7th grade score and the end of 6th grade score).

These norm-referenced differences were compared to the 95% confidence interval of the means calculated from the above t-tests to determine significant differences from the norm. If the norm-referenced difference fell outside of the confidence interval of the mean from the t-test for significance, then the gains were significantly different from the norm-referenced, expected gains for that grade level.

In order to compare the growth of group A to group B, and attempt to answer the second research question: "How does the year of summer school attendance (attending between the 6th and 7th grade year versus attending between the 7th and 8th grade year) affect both summer learning loss and academic achievement?", t-tests were run comparing the pre-treatment gains, summer gains, and post-treatment gains of the two groups to test for significant differences between them. From these t-tests, 95% confidence intervals of the mean were calculated and compared to norm-referenced data on the difference between the gains for each grade level. This allowed for significant departures from the expected normative differences to be identified.

Definition of Terms

Academic achievement: academic progress as measured by NWEA MAP test data taken by students in the fall (beginning of the school year) and spring (end of the school year) of each academic year from kindergarten through 8^{th} grade. The subtests used include mathematics, language usage, and reading. Achievement gains will be calculated for the year prior to summer school attendance, the summer of attendance in the summer school program, as well as the school year following summer school attendance.

Academic achievement gap or achievement gap: a difference in the achievement of students from various socioeconomic backgrounds. Students with higher socioeconomic backgrounds tend to perform better academically than students with lower socioeconomic backgrounds.

FRL: The federal Free or Reduced Lunch Program, whereby students from families of low socioeconomic status qualify for free or reduced price school lunches. In this study, enrollment in the FRL program is used as a proxy for low socioeconomic status.

Group A: A census of students who attended summer school between their 6^{th} and 7^{th} grade years of middle school during the years of study.

Group B: A census of students who attended summer school between their 7^{th} and 8^{th} grade years of middle school during the years of study.

MAP test: Northwest Evaluation Association's Measures of Academic Progress test. This test is a non-grade-leveled, computerized adaptive test that gets progressively more difficult as students respond correctly to questions and simpler if students respond incorrectly. Subtests include mathematics, language usage, and reading. See also: academic achievement.

Middle school: secondary education consisting of the 6^{th} grade through 8^{th} grade years.

NWEA: Northwest Evaluation Association; an association involved in the research and development of educational assessments designed to measure the academic progress of students over time to inform classroom teaching.

Pre Fall: MAP test scores from the fall (beginning of the school year) prior to attendance at summer school.

PREGAIN: The academic growth (shown by difference in MAP test RIT score) for subjects in the school year prior to attendance at summer school.

Pre Spring: MAP test scores from the spring (end of the school year) prior to attendance at summer school.

Post Fall: MAP test scores from the fall (beginning of the school year) following attendance at summer school.

POSTGAIN: The academic growth (shown by difference in MAP test RIT score) for subjects in the school year following attendance at summer school.

Post Spring: MAP test scores from the spring (end of the school year) following attendance at summer school.

RIT score: a Rausch based scoring system which allows for direct comparisons between scores even though students respond to different questions during the course of the test.

STEM: programs or career paths focused on Science, Technology, Engineering, and Mathematics.

SUMMER: The academic growth, or decline, of subjects (shown by difference in MAP test RIT score) for the summer months during which subjects attended summer school.

Summer learning loss: a decrease in academic progress over the months when school is not in session. Summer learning loss will be determined by the difference between a student's Fall Post-treatment score and the Spring Pre-treatment score, showing the change over the out-of-school months due to summer school attendance as compared to the difference in norm scores between these time periods.

Summer school program: a school sponsored program taking place beyond the school year calendar (during the summer months) which gives students extra instruction and practice in English-Language Arts and Math.

Delimitations of Study

The current study involves a population of middle school students from a small, public charter school in a suburban area of the Midwest. The population of treatment groups consisted of a census of students who had attended summer school at the school during their middle school years as well as attended the school in the year prior to the treatment summer and the year following the treatment summer. Students who were retained in grade or who transferred schools during the years of study were excluded from the study, further restricting the sample sizes. The small sample sizes and restricted population limit the generalizability of the study to other populations and to other age groups.

Limitations of Study

The causal-comparative design of the current study allows connections to be drawn between the variables studied, i.e. academic achievement may be related to attendance in the summer school program. However, it does not prove a causal relationship between the variables. The comparison of achievement data and summer learning loss to national normative data provides some ability to determine the strength of a relationship between these variables, but additional experimentation would need to be done to prove the absence of other confounding variables.

Inconsistencies were found in the summer school records from various summers. It is unclear from the available records whether students included on the roster actually attended the full course of the summer school program. In fact, no data on students' actual attendance within the program is available for most years contained within this study. This potentially adds additional confounding variables, in that some students included in the treatment groups may have attended very little of the summer school program while others in the treatment groups may have attended every day of the program.

While the NWEA MAP test is a fairly reliable and valid test of academic achievement (Kingsbury & Hauser, 2004; NWEA, 2011b), and is a less subjective measure of achievement than course grades; some students have reported simply selecting answers randomly in order to finish each subtest quickly, without attempting to deduce the correct answer for each question presented. If this occurs with relative frequency it could affect the results of the study, especially if it occurs with variable frequency in the treatment group versus the general population. It is probable that lower achieving students would be more likely to randomly select answers, and also that lower achieving students would be more likely to attend the summer school program. These invalid test scores could skew the resulting analysis of the data.

Organization of the Thesis

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Chapter Three: Research Design

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Chapter Two: Literature Review

Introduction

The following literature review will discuss the beginning of the long summer vacation in schools and its implications for learning and the growth of the achievement gap between economically disadvantaged students and their more advantaged peers due to summer learning loss. It will discuss the leading theory on summer learning loss and how this theory applies to research findings in the field. Finally, various solutions to lessen summer learning loss will be discussed.

Theoretical Framework

A majority of schools in the United States operate on a calendar that is often referred to as the 'agrarian calendar.' This is a school year that lasts between nine and ten months, with a long summer vacation. Conventional wisdom attributes this calendar to the time of the family farm, when children were needed to help with the planting and harvesting of crops, and thus families required time away from school (Gold, 2002); however, recently, researchers have taken another look at this theory and have found that it does not seem to fit.

The first inconsistency occurs with the timing of the long summer vacation. The greatest amounts of work in rural, agrarian communities occur, not in the middle of summer, but in the spring for planting and in the fall for harvesting (Gold, 2002). These would be the times of the year when children would be most needed to work on the farm and would be less likely to be in school, not during the summer months.

Today, new theories are emerging that the long summer vacation began in cities and urban areas and that the rural/agrarian communities were more likely to be resistant to long summer vacations. Weiss and Brown (2003) found historical documentation that suggests urban concerns, such as epidemics, family vacations, and the psychological well-being of students and teachers, drove the lengthening of the summer break. The rural communities tended to resist these changes, however, since it was easier for them to travel the longer distances required to get children to the school during the milder weather of the summer months.

Whatever the origin, the long summer vacation is a staple of most schools in the country today. Unfortunately, research has shown that these long breaks in schooling can lead to losses in learning over the summer months, particularly for disadvantaged student populations (Sandberg Patton & Reschly, 2013; Alexander, Entwisle, & Olson, 2007a). Alexander, Entwisle, and Olson (2007a) found that disadvantaged elementary students tended to improve in achievement as much as their advantaged peers during the school year, but during the summer they tended to lose or maintain skills while advantaged students continued to gain, although at a slower rate. This produced "a large enough difference to account for almost all the increase in the achievement gap across social lines registered during the elementary school years," (p. 19).

These findings are consistent with the "faucet theory" on schooling (Entwisle, Alexander, & Olson, 1998). According to this theory, the 'faucet' of learning is turned on for all children during the school year and so all children gain. However, during the summer break, the resources of the family and community must supply this commodity in the absence of schools. Families and communities who are poorer do not have the resources available to provide appropriate learning opportunities to further their children's growth and so these children experience very little learning or even learning loss during the months when school is not in session. For these children, the faucet of learning has been turned off or slowed to a trickle when school is out. Middle class families and communities have more resources available to provide learning opportunities for their children, and so the faucet remains on for them, although typically at a slower rate than during the school year.

If these differences truly can account for much of the lower academic achievement seen in disadvantaged student populations, then the question of school accountability in the time of No Child Left Behind comes into question. Can we truly hold schools entirely responsible for the academic growth of students when the family situation of those students can play such a large role in the learning process? The following section will explore this question in more detail with a look at the literature of summer learning and learning loss as well as the efficacy of various options for extending summer learning and preventing summer learning loss in students.

Synthesis of Research Literature

Support for the faucet theory

Since the proposal of the faucet theory, research into summer learning versus school-year learning has produced a sizable body of evidence that largely supports the theory. Using data from the Early Childhood Longitudinal Study, Downey, von Hippel, and Broh (2004) determined that the economic achievement gap grows for kindergarten and first grade students mainly when school is not in session. Their research pointed to different family and community experiences to explain this inequality in learning and determined that schools reduced a large amount of inequality while they were in session.

In addition, much research has focused on reading skill, since that is a key for much other learning. Kim (2004) found that elementary students who are from low income families have lower reading scores in the fall than other students. This same study found that students who do not speak English at home and those diagnosed with special needs also show greater reading losses over the summer than their peers.

Few studies have found little to no summer learning loss in disadvantaged populations. One of note studied only first and second grade struggling readers and found no evidence of academic learning loss over the summer when tested on early literacy skills (Helf, Konrad, & Algozzine, 2008). The subjects of the study were from schools with high levels of free or reduced lunch participation; however, no statistics on the socioeconomic status of the subjects chosen for the study were given. Another found academic gains over the summer in most subjects for first, third, and fifth graders (except for 3rd grade mathematics); however, the subjects for the study were middle class students, and not those from lower socioeconomic backgrounds (Wintre, 1986).

Summer achievement gap implications

It seems from the literature that the achievement gap is at least worsened, if not wholly developed, by the long summer vacations of the typical school calendar. With this in mind, it is important to look into the effects of this achievement gap on both students and schools. Lower achieving and economically disadvantaged students tend to leave school without a diploma at higher rates than other students (Alexander, Entwisle, & Olson, 2007b; Borman, Benson, & Overman, 2005). Additionally, Alexander, Entwisle, and Olson (2007b) found that students from low socioeconomic backgrounds were less likely to be enrolled in college preparatory programs in high school, and less likely to attend college than their peers from higher socioeconomic backgrounds.

The achievement gap along socioeconomic lines does not begin in secondary schools, however. Alexander, Entwisle, and Olson (2007a) found that early elementary students from low socioeconomic backgrounds begin schooling in kindergarten or first grade already lagging behind their more advantaged peers. Then, each summer when school is not in session, they either maintain the progress made during the school year or decline while their more advantaged peers continue to gain. This further widens the achievement gap. An older study by Kuntz and Lyczak (1983) into Title 1 students agrees. Substantial summer losses were found for these students over the summer months in mathematics as well as reading, although smaller declines were found as grade levels increased.

In the age of the No Child Left Behind Act (2001) and Race to the Top legislation (U.S. Department of Education, 2009), schools are being evaluated on the academic gains of their student population. With the literature consistently showing a sizable impact in achievement over the summer months that widens the socioeconomic achievement gap, is it still possible to evaluate the effectiveness of a school on student achievement? It would seem that this type of evaluation would consistently underrate the effectiveness of schools from lower socioeconomic areas, while overrating schools from higher socioeconomic areas.

In response to this problem, Downey, von Hippel, and Hughes (2008) developed a method for evaluating the learning rates and impact of schools separate from any learning during the summer months. The impact in this study is defined as, “the difference between the rate at which children learn in school and the rate at which they would learn if they were not enrolled in school,” (p. 247) and is calculated by subtracting summer learning rates from in-school learning rates. In the analysis, it was found that of the schools currently labeled ‘failing’ under achievement-based methods of evaluation, less than half of them show failing rates of learning and impact under this new evaluative method. Other schools that are currently not labeled ‘failing’ do show failing rates of learning and impact. This study could have strong implications for policymakers and future school evaluation procedures.

Remediating the achievement gap due to summer learning loss

Research into reducing summer learning loss to contract the achievement gap has focused on three main areas: the summer activities of students and families, summer reading programs, and summer school programs. The following sections will address the research into each of these areas in greater detail.

Summer activities. Gershenson (2013) discovered that the way children, age 5 to age 12, spend their time during the summer months varies depending on socioeconomic status. Low income children watch nearly two more hours of television per day and spend less time talking with adults than their higher income peers. It was hypothesized that these activity differences could contribute to the learning loss differences seen between these groups. Another study of adolescent summer time activities found that participation in organized activities correlated with higher achievement levels and well-being, and lower behavior problems, than peers who were not in organized activities but were under the care of themselves, a parent, or another adult care-giver during the summer (Parente, Sheppard, & Mahoney, 2012).

Slates, Alexander, Entwisle, and Olson (2012) compared low socioeconomic status first through fourth grade students who showed summer learning gains to those who showed losses to determine family characteristics that may improve academic achievement over the summer. The biggest contributors to summer learning were found to be more trips to the library during the summer and parents spending more time reading to their children.

Summer reading programs. Research on reading during the summer has shown positive correlations with summer learning. Kim (2004) found that reading even one book during the summer months can improve fall reading scores, independent of prior reading and writing skills. The more books elementary students read over the summer, the higher their fall reading score tended to be. In addition, the same study found that improving access to books over the summer has a positive impact on the amount of summer reading.

Roman and Fiore (2010) had similar results when looking at reading programs through public libraries. Students entering fourth grade who voluntarily participated in these summer reading programs tended to have higher reading scores, and a greater increase in scores, than students who chose not to participate. This study, however, did not find that students who did not participate declined in their reading scores over the summer.

In a meta-analytic study, Kim and Quinn (2013) looked at 35 studies of classroom-based and home-based summer reading programs for kindergarten through eighth grade students. These programs tended to have more positive impacts if they used research-based approaches and they were more effective for lower socioeconomic status students than for higher socioeconomic status students. This may be one way to reduce the growth in the achievement gap over the summer months.

A study by White, Kim, Kingston, and Foster (2013) agrees with these findings. A voluntary reading program was begun at the school that would send books to kindergarten through fifth grade students over the summer months to encourage summer reading. Low income students showed positive reading gains over the summer; however, higher income students showed negative reading gains. None of the treatment effects were significant, but this definitely implies a change from typical data of summer learning.

Summer school programs. Research on summer school programs for improving learning outcomes for students is mixed. Borman and Dowling (2006) attempted a longitudinal study of a three-year summer school program but complications with student mobility and attendance made conclusions difficult. Only about half of participants attended the program regularly enough to make a positive difference in academic achievement. Zvoch (2011) determined that struggling first grade readers participating in a summer literacy program made greater summer gains than nonparticipants, but the gains did not appear to be resilient and these students made slower progress through the following school year than their nonparticipating peers.

Zvoch and Stevens (2013) attempted an experimental design, randomly assigning kindergarten and first grade students to a summer school or non-summer school group. Of those who then attended the five-week summer school program, all showed significant improvement over non-attenders in both literacy and reading fluency. It was noted, however, that students who had been middle achievers in school gained far more from the summer school program than students who had been low achievers. This could potentially increase the achievement gap due to increased summer learning for the more advantaged group, rather than decrease it.

Another literacy-based summer program, studied by Mallette, Schreiber, Caffer, Carpenter, and Hunter (2009), found that a summer school program for 7th and 8th grade students involving tutoring and small group instruction at the students' level (not their grade level) improved literacy significantly. It was also determined that the trusting relationships formed between students and teachers in the program helped students to try harder, pay attention more, and fight with each other less. The importance of relationships to student learning was corroborated in a later study by Keiler (2011) on an urban high school summer school program, which found that respectful relationships between students and teachers made a big impact on student learning in the program.

Other programs have shown positive results as well. Edmonds, O'Donoghue, Spano, and Algozzine (2009) studied a 6-week pre-kindergarten summer literacy program for at-risk students. The program focused on four key pre-literacy skills: letter naming, picture naming, alliteration, and rhyming. Results showed significantly more improvement in letter-naming, picture-naming, and rhyming skills than a control group; however, only picture naming pre-test to post-test differences for the treatment group were found to show statistically significant growth.

Green et al. (2011) examined the effects of a summer enrichment program for urban students in grades three through five. This four-week program offered instruction, tied to the following year curriculum, in science, mathematics, and reading, as well as a curriculum centered on art, character, and self-esteem. Concepts were taught using hands-on, active engagement of the students as much as possible. Pre-tests were compared to post-test data, and some students' scores after the first quarter of the following school year were also collected. The greatest gains in post-test scores occurred in science, followed by mathematics, with the lowest gains occurring in reading.

Many summer school programs lack the proper funding, consistency, and structure that are necessary for measured results (Sojka, 2012). The Southern Regional Education Board (SREB, 2002) reported that in a survey of over 1000 southern U.S. schools, two-thirds ran summer programs but few reported using carefully planned, high-quality instruction. Many recommendations for improving summer school programs have come out of recent research. In order for a summer program to be effective it should have a set curriculum with well-defined goals (Sojka, 2012), focused on reading (Alexander, Entwisle, & Olson, 2007a), that aligns well with the school-year curriculum (Borman & Dowling, 2006), includes field trips and fun activities to increase student interest and attendance (Borman & Dowling, 2006), and requires or at least encourages parental involvement (Slates et al., 2012).

Nearly all of the research on summer school programs described above focused on either the early elementary school years or on the high school years. Very little research has been done specifically on these interventions in middle school. Li, Alfeld, Kennedy, and Putallaz (2009) conducted a study on the effects of a middle school summer enrichment program on high school test taking, high school course-taking, and college major. They found that students who attended the math and science enrichment program were more likely to begin taking advanced placement and higher level math classes earlier in their high school career. They were also more likely to major in math or science in college. This provides support for the importance of the middle school years in helping to shape the high school trajectory and beyond. More attention needs to be paid to improve learning outcomes for struggling learners in middle school.

Summary

The widely used school calendar that includes a long summer vacation can be detrimental to learning, particularly for students from low socioeconomic backgrounds (Downey, von Hippel, & Broh, 2004). The families and communities of low income students do not have the resources to provide appropriate learning opportunities outside of the school year to extend learning over the summer months (Entwisle, Alexander, & Olson, 1998). Since middle and upper income families and communities have better access to these types of resources, lower income students fall further behind their peers each summer, widening the achievement gap, even though they tend to make similar gains during each school year (Alexander, Entwisle, & Olson, 2007a). This achievement gap can have long-term consequences for students since low income students tend to be less likely to be enrolled in college preparatory programs due to their lower test scores, and they tend to be more likely to drop out of school before earning their diploma (Alexander, Entwisle, & Olson, 2007b).

Schools and communities have implemented various strategies for better utilizing the summer months to reduce the learning loss that often follows summer vacation. Reading programs by schools and public libraries have shown promise in improving literary skills, especially among disadvantaged students (Kim & Quinn, 2013; White et al., 2013). Summer school programs can improve academic achievement as well, particularly for literacy (Edmonds et al., 2009; Mallette et al., 2009; Zvoch, 2011; Zvoch & Stevens, 2013). However, schools must be careful to direct their summer school efforts toward disadvantaged, low achieving students or risk widening the achievement gap further (Zvoch & Stevens, 2013).

Conclusion

Schools must implement interventions that will improve outcomes for students from disadvantaged backgrounds. The families and communities of these students are not able to provide the same quality of learning opportunities for these students, and so each summer they fall further and further behind their more advantaged peers. The interventions that schools provide must be carefully planned and targeted specifically for disadvantaged, at-risk students to prevent the achievement gap from widening further. These interventions should attempt to extend learning time for these students over the summer months to prevent summer learning loss, whether through summer reading programs or summer school programs. They must begin early, even as early as the pre-school years, but extend through the secondary grades to continue to narrow the achievement gap. Much research has been conducted on programs either at the elementary grades or at the high school level. Very few studies have looked specifically at summer programs for middle school students. The following chapters describe such a study.

Chapter Three: Research Design

Introduction

The current study explores the use of a summer school program for middle school students at a public charter school for improving academic achievement and reducing summer learning loss. It employs a causal-comparative design using existing data and existing groups. The main goal is to determine if attending the summer school program at the school reduces summer learning loss and improves academic achievement for middle school students. Two research questions drive the collection of data and the resulting analysis:

1. How does completion of the summer school program affect summer learning loss and academic achievement for middle school students as compared to national norms of learning loss and achievement?
2. How does the year of summer school attendance (attending between the 6th and 7th grade year versus attending between the 7th and 8th grade year) affect both summer learning loss and academic achievement?

It is hypothesized that attending the summer school program in middle school would lead to greater academic achievement gains than the norm-referenced achievement gains for the summer months and for the year following attendance in the program. The efficacy of summer school is well researched in the literature for students in the elementary grades, particularly lower elementary, as well as for high school credit recovery and remediation. However, much of the research on summer programs for middle school students centers around enrichment programs designed to interest students in certain career paths, such as science, technology, engineering, and mathematics (STEM) programs (Li, Alfeld, Kennedy, & Putallaz, 2009).

The literature often reported interventions earlier in the school career to be more advantageous for academic success than later interventions (Campbell & Ramey, 1994; O'Connor, Bocian, Sanchez, & Beach, 2014). However, no studies were found discussing specifically the timing of summer school attendance during the middle school years. Because of this, it is hypothesized that attending the summer school program during the summer following 6^{th} grade would produce more achievement gains during the summer and the post-treatment school year than attending during the summer following 7^{th} grade. The following sections of this paper will describe the subjects included in the study, the instruments used, the data collection process, and the analysis of the data. It will conclude with a summary of the research design.

Subjects

The population for the study consists of middle school students at one Midwest public charter school during the 2010 through 2013 school years. It is a college preparatory school which maintains slightly less than 900 students in Kindergarten through 12^{th} grade. Subjects for the study consisted of a census of students who attended the summer school program at the school following their 6^{th} grade year or 7^{th} grade year of middle school between the fall of 2010 and the spring of 2014. Participants were included in the study if they attended the charter school during the school year before, as well as the school year following, summer school attendance. Excluded subjects included those who were retained in grade and those who transferred to another school district during the years contained within the study. The census produced two groups of subjects, one where subjects attended the summer school program between their 6th and 7th grade years (Group A, n=29) and a second where subjects attended the summer school program between their 7th and 8th grade years (Group B, n=31).

Instrumentation

The school utilizes Infinite Campus, a secure, web-based software, as a repository for student demographics, gradebooks, behavior, and other student data. Demographic information for subjects within this study was compiled, in aggregate, from the information contained within Infinite Campus by an administrator at the school. As with all database information, errors in coding are always a possibility.

Achievement data for the study was taken from the Northwest Evaluation Association's (NWEA's) Measures for Academic Progress (MAP) test. The MAP test is required for schools chartered by Grand Valley State University to determine student growth and to identify areas for improvement. This test is designed to measure student growth in the areas of mathematics, language usage, and reading. It is a computerized adaptive test, with the difficulty of questions driven by student performance, rather than grade level (Kingsbury & Hauser, 2004). As students respond correctly to questions, more difficult questions will follow. If a student responds incorrectly, a simpler question will follow. In this way, the test is designed to narrow in on the current ability level of each student, regardless of current age or grade level. This would be expected to show any learning loss over the summer months more accurately than tests that are leveled by grade, since students would take a more difficult test at the beginning of the higher grade level than they did at the end of the previous grade (Wu, West, & Hughes, 2008).

According to the Technical Manual for the MAP test (NWEA, 2011b), the NWEA employed the Rasch model of Item Response Theory (IRT) in the development of the MAP test scale. This produced an equal interval scale on the logit metric, which was used to design the RIT (Rasch unIT) scale. Each item in the test bank is given a difficulty value that is related to level of achievement. RIT scale scores from different students can then be compared directly, even though students are not responding to the same questions from the test bank (NWEA, 2011b).

The MAP test has enjoyed very high reliability and validity ratings as do other computerized adaptive tests (Kingsbury & Hauser, 2004). In a test-retest scenario, typically subjects would be given exactly the same test at two different time periods. However, with a computerized adaptive test such as the MAP, the questions presented are dependent on answers to previously given questions and so subjects take a different, although equivalent test each time. Another difference in the testing procedure with the MAP test is that retest sessions are typically months past the original test, rather than weeks. This would typically lead to lower reliability coefficients. With this type of test-retest procedure, the correlation coefficients remain high for the MAP, consistently in the high 0.7 to low 0.9 range (NWEA, 2011b).

Concurrent validity has been well documented for the MAP test in the form of Pearson correlation coefficients. For middle school grades, these validity coefficients range from 0.6 to 0.8 for reading, and 0.7 to high 0.8s for math (NWEA, 2011b).

Predictive validity of the MAP is also good, ranging from 0.68 to 0.8 for reading with most scores in the 0.7's, and 0.58 to 0.87 for math with most coefficients in the low to mid 0.8's for middle school (NWEA, 2011b). It was noted that both concurrent and predictive validity scores for the MAP were much lower when the comparison test was more performance-based or involved more subjective scoring practices, than when the comparison test was a selected response assessment (NWEA, 2011b).

Data Collection

Demographic information for subjects within this study was compiled, in aggregate for each treatment group, from the information contained within Infinite Campus by an administrator at the school. All NWEA MAP test data was compiled by an administrator of the school, replacing student names with numbers to ensure subject confidentiality. As with all database information, errors in coding are a possibility.

Subject achievement data for the current study was measured by the NWEA MAP test in mathematics, language usage, and reading. The school began taking the MAP test during the fall of 2010 (the beginning of the 2010 school year), and as of the time of the study, data was available through the spring of 2014 (the end of the 2013 school year). Testing data was gathered from the fall testing period, which typically begins within one week of the start of school, as well as the spring testing period which typically begins three weeks prior to final exams. Each testing period requires two to three weeks to ensure all students have the opportunity to test in all three subject areas in the school's computer lab. Fall and spring testing data was gathered for subjects during the year before (Pre Fall and Pre Spring) as well as the year following (Post Fall and Post Spring) attendance at summer school.

Data was collected separately for each of the two treatment groups, A (attended summer school between 6th and 7th grade) and B (attended summer school between 7th and 8th grade). All MAP test data was entered into an excel spreadsheet which was then uploaded into SAS software for data analysis. The potential for data entry errors exists with the use of the spreadsheet as well as data entry into SAS.

Data Analysis

For each treatment group a variety of descriptive statistics were calculated, including mean group scores for each test subject (language usage, mathematics, and reading) across the four time periods: Pre Fall, Pre Spring, Post Fall, and Post Spring. Following this, three primary calculations were used in further analysis to show academic achievement gains or losses during different time periods for different test subject areas. First, a difference in RIT score between the spring and fall of the pre-treatment year was calculated to show the student's academic achievement gains before summer school attendance (PREGAIN). Second, the fall post-treatment RIT score was subtracted from the spring pre-treatment RIT score to obtain a measure of summer learning, or learning loss if negative (SUMMER). Finally, a difference between the spring and fall of the post-treatment year was used to show the student's academic gains after summer school attendance (POSTGAIN).

Two sampled t-tests were performed on these achievement differences using SAS version 9.3 (SAS Institute Inc., Cary, NC) to determine if significant changes were seen in student's scores. Since the same student data was used for three separate within-subject t-tests, the significance level needed to be adjusted to correct for type 1 error. For all t-test analyses, p-values will be considered significant at $p \leq 0.016$ ($\alpha^* = \alpha/3$).

Following these t-test calculations, the 95% confidence interval of the mean was calculated to determine if significant differences (gains or losses) occurred. These confidence intervals were then compared to differences calculated from the 2011 Nationwide Normative Data (NWEA, 2011a) for the MAP test. This data provided a reliable basis for comparison due to the much larger population and sample sizes (over 20,000 students per grade level) used to generate the norms. Raw data and calculated differences for the middle school grades can be found in Table 1.

Table 1

Nationwide normative MAP test scores and calculated score differences for the middle school years.

Grade Level	Subject Area	Beginning of Year	End of Year	School Year	Summer
6th	Mathematics	219.6	225.6	6.0	0.0
	Language Usage	212.3	216.2	3.9	-0.4
	Reading	212.3	216.4	4.1	-0.1
7th	Mathematics	225.6	230.5	4.9	-0.3
	Language Usage	215.8	218.7	2.9	0.0
	Reading	216.3	219.7	3.4	-0.4
8th	Mathematics	230.2	234.5	4.3	
	Language Usage	218.7	221.3	2.6	
	Reading	219.3	222.4	3.1	

Note. School Year = Gains calculated End of Year – Beginning of Year. Summer = Gains calculated Beginning of Year for following grade level – End of Year for current grade level. A negative value for Summer Gain indicates a loss of learning over the summer.

The comparison of the PREGAIN scores to calculated differences in the norm data allowed for the identification of any significant differences between the subjects of this study and the norm group. If the normed differences for PREGAIN, SUMMER, and POSTGAIN fell within the 95% confidence interval for the mean (calculated from the t-tests described above) of the PREGAIN, SUMMER, and POSTGAIN scores, then academic achievement gains or losses were not statistically different from what would be considered normal gains or losses for that grade level.

Two sampled t-tests ($p \leq 0.016$) were also run to compare the academic growth of group A and group B. The Satterthwaite method was utilized to maintain consistency for these tests since the variance was not always equal between the two groups. One of the goals of the study is to identify whether the timing of summer school attendance makes a difference for academic gains. The t-tests provided a basis for identifying significant differences in gains between the two groups. If a difference was significant, the sign of the values on the confidence interval indicated which group made significantly better gains. Negative confidence interval values indicated better gains for group A over group B, where positive values indicated the opposite. The 95% confidence intervals from these tests were also compared to the differences seen between these groups in the normative data to determine if the achievement gains were statistically different from the normal, expected differences in gains between these grade levels.

Summary

The purpose of the current study is to determine the effects of a summer school program on the degree of summer learning loss and academic achievement of middle school students. It also seeks to determine whether the timing of the intervention during the middle school years has an impact on these effects. It was hypothesized that the summer school program would reduce summer learning loss and improve academic achievement for all attending students, and that those attending earlier during their middle school years would see greater improvements than those who attended later in their middle school career.

Subjects consisted of a census of middle school students who attended the summer school program at a Midwest public charter school between the fall of 2010 and the spring of 2014. This census produced two groups of students, one group who attended summer school between their 6th and 7th grade year (n=29), and the second group who attended summer school between their 7th and 8th grade year (n=31).

All achievement data was taken from the NWEA's MAP test, a non-grade-leveled, computerized adaptive test, with subtests in language usage, mathematics, and reading. Student scores for each subtest are produced in RIT (Rasch unIT) scores which is an equal interval scale. The MAP test has very high reliability (consistently around 0.8 to 0.9) as well as good concurrent validity (0.7 to 0.8) and predictive validity (around 0.8) with most standardized state testing.

MAP test data for the fall and spring of the school year prior to attendance at summer school and the fall and spring of the school year following attendance at summer school was entered into an excel spreadsheet, and then uploaded into SAS software for data analysis. Two sampled t-tests were run for each subject area (language usage, mathematics, and reading) as well as for each group to determine significance of score increases or decreases (due to corrections for type 1 error, significance levels were adjusted at $p \leq 0.016$). These t-tests were also used to calculate a 95% confidence interval of the mean.

National normative data on the MAP test (NWEA, 2011a) was used as the comparison group for the current study. Norm-referenced gains for each grade level were compared to the calculated confidence intervals above. If the norm-referenced value fell within the confidence interval, then the result was not considered to be significantly different from expected norms for that grade level.

A two sampled t-test was also calculated to compare the two groups (A and B) to determine differential effects based on grade level (again at $p \leq 0.016$), and a 95% confidence interval was calculated utilizing the Satterthwaite method for unequal groups. This confidence interval was also compared to calculated norm-referenced differences to determine whether differences seen conformed to expected normal differences in gains between the grade levels.

Chapter Four: Results

Chapter four of this thesis is divided into three sections: context, findings, and summary. The context will describe the information about the summer school program gleaned throughout the data collection and the demographic characteristics of the two groups of subjects involved in the study. The findings section details the statistical results of the analysis as it relates to the two research questions driving the current study. This section also contains tables related to the descriptive and inferential statistics performed on the data. Finally, the summary section will highlight the key results which will be discussed further in chapter five.

Context

Data was gathered from a small public charter school located in the Midwest which conducted an annual summer school program for academically struggling students in the areas of mathematics, reading, and writing. Attendance data for the summer school program was difficult to locate for the years of interest to the current study. For two of the three summers included in the study, no daily attendance records were available. This lack of data provided a severe limitation on the scope of the current study as it was not possible to determine whether subjects included in the study attended only one day of the program or every day of the program.

For the records that could be obtained on the summer school programs, demographic characteristics were compiled, in aggregate, for each treatment group by an administrator at the school. Group A contained a total of 29 subjects. Within Group A, 65.5% of participants were male (n=19) and 34.5% were female (n=10); 27.6% began the 6th grade year in 2010, 31.0% in 2011, and 41.4% in 2012. Forty-four point eight percent (n=13) of the group participated in the free or reduced lunch program (FRL) and 27.6% (n=8) received special education services. Racially, the group is mostly white (62.1%) and Hispanic/Latino (34.5%), with only one subject listed as American Indian or Alaskan native (3.4%).

Group B consisted of 31 subjects and contained a nearly identical split in gender with 64.5% male (n=20) and 35.5% female (n=11) subjects, 16.1% of whom began the 7th grade year in 2010, 45.2% in 2011, and 38.7% in 2012. A higher percentage of these subjects, 54.8% (n=17), participated in FRL and only 16.1% (n=5) received special education services. The majority of these subjects were listed as white (61.3%) or Hispanic/Latino (32.3%), although an additional 6.5% were identified as belonging to two or more races.

Findings

Research question 1: How does completion of the summer school program affect summer learning loss and academic achievement for middle school students as compared to national norms of learning loss and achievement?

Table 2 presents a summary of the descriptive statistics of the data for groups A and B. Mean scores on all three subject area tests are given for each group for the four time periods: pre-treatment fall (Pre Fall), pre-treatment spring (Pre Spr), post-treatment fall (Post Fall), and post-treatment spring (Post Spr). Table 2 allows visual comparison of gains as well as some learning losses of both groups during the years of study. Overall, subjects in both groups improved in language usage (group A: +8.27, group B: +7.52), mathematics (group A: +10.33, group B: +9.82), and reading (group A: +6.08, group B: +6.35) during the course of the two school years; however, some learning losses over the summer are evident, particularly noticeable for group B mathematics (-2.95) and reading (-1.83), even though subjects attended summer school during that time.

Table 2

MAP test descriptive statistics for pre-treatment school year (Pre Fall and Pre Spr) and post-treatment school year (Post Fall and Post Spr) for groups A and B by test subject.

MAP Test Subject	Grp	Test Time	N Miss	N	Mean	Std Dev	Min	Med	Max
Language Usage	A	Pre Fall	0	29	206.69	8.78	188.00	206.00	222.00
		Pre Spr	0	29	213.24	8.58	194.00	214.00	228.00
		Post Fall	0	29	213.07	11.04	186.00	211.00	242.00
		Post Spr	2	27	214.96	9.96	183.00	215.00	232.00
	B	Pre Fall	0	31	211.90	10.73	183.00	213.00	232.00
		Pre Spr	2	29	212.90	9.64	190.00	214.00	229.00
		PostFall	1	30	214.77	10.55	175.00	216.00	232.00
		PostSpr	0	31	219.42	8.95	203.00	220.00	234.00
Mathematics	A	Pre Fall	1	28	210.39	9.28	191.00	212.00	225.00
		Pre Spr	1	28	215.79	10.54	195.00	216.00	235.00
		Post Fall	0	29	218.14	10.55	195.00	219.00	237.00
		Post Spr	0	29	220.72	14.54	166.00	221.00	239.00
	B	Pre Fall	0	31	219.35	11.26	194.00	222.00	242.00
		Pre Spr	0	31	222.23	11.32	199.00	221.00	244.00
		Post Fall	2	29	219.28	11.55	192.00	220.00	239.00
		Post Spr	1	30	229.17	11.26	203.00	229.50	250.00
Reading	A	Pre Fall	1	28	208.75	10.65	184.00	209.50	228.00
		Pre Spr	1	28	211.11	11.43	181.00	212.50	227.00
		Post Fall	0	29	213.86	11.14	182.00	217.00	230.00
		Post Spr	0	29	214.83	11.51	187.00	216.00	232.00
	B	Pre Fall	0	31	214.71	11.67	188.00	216.00	230.00
		Pre Spr	1	30	217.80	10.91	187.00	220.00	232.00
		Post Fall	1	30	215.97	9.60	200.00	215.00	234.00
		Post Spr	0	31	221.06	12.14	197.00	223.00	241.00

Note. Grp = the group of subjects. N Miss = the number of missing data points within the group for this data set.Pre Spr = spring pre-treatment scores. Post Spr = spring post-treatment scores.

Since data was used for three separate within-subject t-tests, the significance level needed to be adjusted to correct for type 1 error. For all t-test analyses, p-values will be considered significant at $p \leq 0.016$ ($\alpha^* = \alpha/3$). Two sample t-test analyses were conducted on group A gains (PREGAIN, SUMMER, and POSTGAIN). As can be seen in

Table 3, only two gains were found to be significant: PREGAIN in language usage ($p < 0.0001$) and PREGAIN in mathematics ($p = 0.0009$). All other gains or losses by this group were not statistically significant.

T-test analyses for group B gains can also be found in Table 3. All POSTGAIN scores (language usage, mathematics, and reading) for group B were significant at the $p \leq 0.016$ level (at $p = 0.0152$, $p < 0.0001$, and $p = 0.0098$, respectively). No PREGAIN or SUMMER gains show significant differences for this group.

Table 3

Significance of pre-treatment (PREGAIN), summer (SUMMER), and post-treatment (POSTGAIN) gains in MAP test scores via t-test analyses.

Test Subject	Group	Comparison	p-value
Language Usage	A	PREGAIN	<0.0001*
		SUMMER	0.9118
		POSTGAIN	0.4585
	B	PREGAIN	0.4594
		SUMMER	0.1966
		POSTGAIN	0.0152*
Mathematics	A	PREGAIN	0.0009*
		SUMMER	0.0290
		POSTGAIN	0.2288
	B	PREGAIN	0.0553
		SUMMER	0.1033
		POSTGAIN	<0.0001*
Reading	A	PREGAIN	0.2678
		SUMMER	0.1924
		POSTGAIN	0.6386
	B	PREGAIN	0.2576
		SUMMER	0.4322
		POSTGAIN	0.0098*

**significant at p ≤ 0.016*

Note. α* indicates p ≤ 0.016 for significance level. PREGAIN = pre-treatment spring score (Pre Spring) – pre-treatment fall score (Pre Fall). SUMMER = post-treatment fall score (Post Fall) – pre-treatment spring score (Pre Spring). POSTGAIN = post-treatment spring score (Post Spring) – post-treatment fall score (Post Fall).

For both groups, 95% confidence intervals of each mean were calculated from the above t-tests to use in comparisons to the norm-referenced data. If the norm-referenced difference did not fall within the calculated confidence interval, then the group gains or losses for that time period did not encompass the normal gains or losses expected for the group. The group gains or losses can then be thought to be significantly different from the norm. The calculated 95% confidence intervals, as well as the norm-referenced differences, can be found in Table 4 for both group A and group B data.

When comparing the 95% confidence interval of the mean for group A to the normative data (Table 4) for the same grade level, no significant departure from the norm for academic gains or losses before, during, or after attending the summer school program were found. However, two particular data points of note for group A show that the 95% confidence interval of the mean barely captures the norm value: SUMMER gain in mathematics (-0.28 to 5.78 confidence interval and 0.0 norm value) and PREGAIN in language usage (3.03 to 10.07 confidence interval and 3.9 norm value).

One of the gains shown by group B is significantly beyond the norm-referenced expected gain (Table 4). The 95% confidence interval for POSTGAIN mathematics (6.16 to 11.69) is much higher than the norm-referenced gain (4.3) for that time period. No other group B gains differ significantly from the norm data.

Table 4

Comparison of t-test confidence intervals to norm-referenced differences to determine departures from the norm.

MAP Test Subject	Group	Comparison	95% CI of the Mean from t-tests		Norm-Referenced Differences
Language Usage	A	PREGAIN	3.03	10.07	3.9*
		SUMMER	-4.08	3.74	-0.4
		POSTGAIN	-3.19	5.85	2.9
	B	PREGAIN	-2.63	4.84	2.9
		SUMMER	-1.87	5.94	0.0
		POSTGAIN	0.08	8.46	2.6
Mathematics	A	PREGAIN	1.50	7.83	6.0
		SUMMER	-0.28	5.78	0.0*
		POSTGAIN	-2.75	7.92	4.9
	B	PREGAIN	-0.77	6.51	4.9
		SUMMER	-5.19	1.05	-0.3
		POSTGAIN	6.16	11.69	4.3**
Reading	A	PREGAIN	-3.11	8.07	4.1
		SUMMER	-2.26	7.26	-0.1
		POSTGAIN	-4.19	6.13	3.4
	B	PREGAIN	-2.90	7.77	3.4
		SUMMER	-5.77	3.01	-0.4
		POSTGAIN	0.41	9.39	3.1

**nearly significant   **significant at p ≤ 0.016*

Note. Confidence interval data derived from t-test for significant differences in scores at $p \leq 0.016$. Norm-Referenced Differences = the calculated difference for the same grade level interval as the comparison score, derived from the national norm-referenced values (NWEA. 2011a).

Research question 2: How does the year of summer school attendance (attending between the 6th and 7th grade year versus attending between the 7th and 8th grade year) affect both summer learning loss and academic achievement?

Comparisons between the academic growth of group A and group B via two sample, Satterthwaite adjusted t-test ($p \leq 0.016$) can be found in Table 5. Three comparisons showed a significant difference in the academic gains of the two groups: PREGAIN for language usage ($p = 0.0093$), SUMMER for mathematics ($p = 0.0068$), and

POSTGAIN for mathematics (p = 0.0105). Two of these three, PREGAIN in language usage and SUMMER in mathematics, indicate group A made significantly better gains than group B, shown by the negative values in the confidence intervals (since group B – group A was used here). For POSTGAIN mathematics, group B made significantly better gains than group A. Although both groups attended summer school, it appears that group A made significantly better gains in mathematics during the course of summer school while group B made better gains in the school year following attendance at summer school.

Table 5

Significance of differences between group A and B gains during pre-treatment school year (PREGAIN), summer attending summer school (SUMMER), and post-treatment school year (POSTGAIN).

MAP Test Subject	Comparison	p-value	95% Confidence Interval of the Mean		Significant Difference
Language Usage	PREGAIN	0.0093*	-10.42	-0.48	A > B
	SUMMER	0.3152	-3.15	7.56	
	POSTGAIN	0.2315	-3.04	8.90	
Mathematics	PREGAIN	0.3489	-6.47	2.88	
	SUMMER	0.0068*	-9.03	-0.60	A > B
	POSTGAIN	0.0105*	0.46	12.22	B > A
Reading	PREGAIN	0.9874	-7.53	7.44	
	SUMMER	0.1337	-10.15	2.39	
	POSTGAIN	0.1504	-2.70	10.57	

** indicates significance at p ≤ 0.016.*

Note. Significant Difference = indicates the direction of increased gains for significant differences.

For the above t-tests comparing the two groups, the 95% confidence intervals of the means (using group B – group A) were used to compare to the norm-referenced differences as well. When these confidence intervals were compared to the norm-referenced differences between grade level gains, only two areas show significant differences from the norm or expected differences: SUMMER mathematics gain difference favoring group A gains (-9.03 to -0.60 confidence interval and -0.3 norm difference) and POSTGAIN mathematics gain difference favoring group B gains (0.46 to 12.22 confidence interval and -0.6 norm difference). The PREGAIN difference for language usage was not significant, although it fell within 0.52 of being significantly different from the norm-referenced value. Confidence interval values and norm-referenced differences between the grade levels can be found in Table 6.

Table 6

Comparison of 95% Confidence Interval of the Mean from the t-tests for significant differences to the norm-referenced differences to determine departures from the norm.

MAP Test Subject	Comparison	95% CI of the Mean from t-tests		Norm-Referenced Difference	Significant Difference
Language	PREGAIN	-10.42	-0.48	-1.0*	
Usage	SUMMER	-3.15	7.56	0.4	
	POSTGAIN	-3.04	8.90	-0.3	
Mathematics	PREGAIN	-6.47	2.88	-1.1	
	SUMMER	-9.03	-0.60	-0.3**	A > B
	POSTGAIN	0.46	12.22	-0.6**	B > A
Reading	PREGAIN	-7.53	7.44	-0.7	
	SUMMER	-10.15	2.39	-0.3	
	POSTGAIN	-2.70	10.57	-0.3	

**indicates nearly significant   **indicates significance*

Note. Norm-Referenced Difference = the difference in norm scores over the same time period as the comparison difference. Significant Difference = indicates the direction of increased gains for significant differences.

Summary

For all PREGAIN scores, the norm-referenced values are captured within the 95% confidence interval of the mean. This reinforces the use of the national norm data as a comparison group for this study since the treatment group academic gains are not statistically different from the norm gains prior to treatment. However, group B did prove to be significantly different from the norm gains in the area of POSTGAIN mathematics. While group A showed no significant differences from expected values, the norm score was barely captured by the confidence interval for SUMMER mathematics gain.

The two groups differed from each other on gains in PREGAIN language usage, SUMMER mathematics, and POSTGAIN mathematics. Of these, only SUMMER and POSTGAIN mathematics were significantly different from the computed differences in the norm-referenced scores for these grade levels. However, the PREGAIN language usage norm difference was barely captured by the 95% confidence interval of the means. The following chapter will discuss these findings in further detail, as they relate to the theory presented in the literature and the hypotheses of the current study.

Chapter Five: Conclusion

Summary of the Study

Many students are losing academic ground over the long summer vacations away from school, particularly students from low socioeconomic backgrounds. These students begin school behind their peers and fall further behind each summer, widening the achievement gap each school year. Schools and communities are trying to bridge that gap by implementing summer programs that can extend learning over summer vacation and improve academic outcomes for disadvantaged students. These programs include summer reading programs and summer school programs.

The current study sought to determine the effectiveness of the summer school program at a small public charter school in the Midwest for decreasing summer learning loss and improving academic achievement for middle school students. Student test scores were collected for the fall (beginning of the school year) and spring (end of the school year) of the school year prior to their attendance at summer school as well as for the fall and spring of the school year following summer school attendance. This allowed for calculations of academic gains during the pre-treatment school year (PREGAIN), over the summer months (SUMMER), and during the post-treatment school year (POSTGAIN) for two groups of students: those who attended summer school between their 6th and 7th grade years, and those who attended summer school between their 7th and 8th grade years. All academic gains were compared to national normative data (NWEA, 2011a) for student gains over the same grade levels. The two groups of subjects were also compared to each other to determine whether summer school improves academic achievement differently across the middle school years.

Results of t-test analyses of the data showed that no PREGAIN scores were different from what the normative data would predict, although one was close to being significantly different: group A PREGAIN language usage. This reinforces the use of the national normative data as a comparison group for the subjects of the current study. Significant departures from normed differences were found for group B POSTGAIN mathematics, although group A SUMMER gains for mathematics were very close to being significant as well. No other group differences were significantly different from the predicted gains according to the normative data.

When the two groups were compared in gains, three significant differences between them stood out: PREGAIN language usage, SUMMER mathematics, and POSTGAIN mathematics. Both PREGAIN language usage and SUMMER mathematics showed group A gaining significantly more than group B; however, in POSTGAIN mathematics the opposite was true. Of these three, only the mathematics gains (both SUMMER and POSTGAIN) differed significantly from the expected normative differences.

Conclusion

In attempting to answer the first research question: "How does completion of the summer school program affect summer learning loss and academic achievement for middle school students as compared to national norms of learning loss and achievement?", mixed results were obtained. According to the results of the current study, attending the summer school program at the school does appear to improve academic achievement in mathematics. Subjects in group B achieved greater mathematics growth than the norm would have predicted in the school year following attendance in the summer school program, and subjects in group A achieved nearly higher than the norm mathematics growth in the summer during summer school attendance. This lends support for the efficacy of the mathematics portion of the summer school program in improving academic achievement in mathematics.

The other subjects, reading and language usage, however, did not show any significant differences from the expected growth levels based on normative data. This would reflect that the English/Language Arts portion of the summer school program is not making as great an impact as the mathematics portion.

The hypothesis for research question one: attending the summer school program in middle school would lead to greater academic achievement gains than the norm-referenced achievement gains for the summer and for the year following attendance in the program, cannot be fully accepted in light of the results. It would appear that this statement is largely true for mathematics (with differential gains depending on grade level); however, not at all true for reading and language usage. Possible explanations for this difference will be addressed in the discussion section to follow.

The second research question, “How does the year of summer school attendance (attending between the 6th and 7th grade year versus attending between the 7th and 8th grade year) affect both summer learning loss and academic achievement?”, also produced mixed results. The significant differences between the two groups occurred in three areas: higher pre-treatment gains in language usage for group A, higher summer school gains for mathematics for group A, and higher post-treatment gains in mathematics for group B. The PREGAIN language usage difference was not, however, significantly different from the expected difference predicted by the normative data.

The mathematics results are interesting, however, (added to their significant and nearly significant growth seen above) since it appears that attending summer school between the 6^{th} and 7^{th} grade year provides greater summer learning gains for this group of students, but that attending summer school between 7^{th} and 8^{th} grade provides greater academic achievement gains in the school year following summer school attendance. It would appear that the timing of the summer school intervention in middle school has differing effects on the mathematics achievement growth of students.

As with the results for research question one, no other reading or language usage differences were statistically significant from the predicted differences based on the normative data. Students in the summer school program did not perform significantly better in one grade level than in another for these academic subjects.

With these results, the hypothesis for research question two: attending the summer school program during the summer following 6^{th} grade would produce more achievement gains during the summer and the post-treatment school year than attending during the summer following 7^{th} grade, can only be partially accepted. It does appear to be true for mathematics that attending summer school following the 6^{th} grade year produced significant summer learning gains over attendance following the 7th grade year, somewhat greater gains than the normative data would predict; but the mathematics achievement for the year following summer school attendance was significantly higher (and significantly differed from the norm) for subjects attending summer school following their 7th grade year. This result does not hold true for reading or language usage where no significant differences were found, other than pre-treatment gains for language usage, which was not significantly different from what the normative data would expect.

Discussion

The ‘faucet theory’ of education (Entwisle, Alexander, & Olson, 1998) would predict a loss of learning over the summer months. The national normative data, shown in Table 1 of the current study, shows some small learning losses in some areas, as well as some areas which show no gain or loss over the summer. This may be due to the large sample sizes included in the 2011 Norms Study (NWEA, 2011a), since some studies have shown learning gains for students from middle and upper socioeconomic backgrounds over the summer (Alexander, Entwisle, & Olson, 2007a; Wintre, 1986) while those from low socioeconomic backgrounds tend to show learning losses (Alexander, Entwisle, & Olson, 2007a; Slates, et al., 2012). Averaging these two groups together into the Norms Study may have produced little to no change in learning over the summer.

The current study does promote the use of a summer school program for improving academic achievement, particularly for mathematics. Summer school can be a useful way to reduce the achievement gap for disadvantaged students by reducing the amount of summer learning loss. During the summer months it may be that these struggling students have few opportunities to practice mathematics skills, which makes the mathematics component of a summer school program particularly necessary.

The differential results for mathematics versus reading and language usage found in the current study may have more to do with the administration and curriculum of the summer school program at this school than with the students and their learning. The mathematics curriculum of the summer school program at the school had been designed and led for multiple years, including the years contained within the current study, by the head of the 6-12 mathematics department. Various mathematics teachers have taught this summer school curriculum, but careful planning has occurred within the department that seems to be paying off. The curriculum focused on core mathematics concepts that students encountered during the previous year as well as some that they would encounter during the beginning of the following school year, in a way that was as hands-on and experiential as possible for the students. It was designed to be as precise and individual as possible, pin-pointing areas for improvement for each student and designing activities to improve on these core deficiencies. Much of the literature on summer school programs recommends that they be carefully designed (SREB, 2002), employ active or hands-on learning strategies (Keiler, 2011; Omelicheva, 2012), and be tied to the school year curriculum (Alexander, Entwisle, & Olson, 2007a; Borman & Dowling, 2006). It would seem that the mathematics portion of the school's summer school program is putting these research-based strategies into practice.

On the other hand, the reading and writing portion of summer school has had less direction during the time of the current study. With different teachers from summer to summer and less precision in individualizing the summer program to meet students' core deficiencies, this part of the summer school program has not enjoyed the same consistency as mathematics. These inconsistencies in the program may have led to varying degrees of curriculum alignment, rigor, and creativity of tasks, depending on the summer. One of the summers under study may have been an excellent program and produced excellent results; however, the remaining data could have skewed the means toward a more mediocre outlook.

In any case, the reading and language usage gains for students who attended summer school were not different from the expected norms for middle school students. This runs contrary to much research into summer learning loss that highlights reading and literacy skills as key components in preventing the loss of learning over the summer months (Edmonds et al., 2009; Kim, 2004; Kim & Quinn, 2013). However, it must be noted that these students also did not experience large summer learning losses in reading and language usage predicted by the literature (Kim, 2004; Kim & Quinn, 2013), even though roughly half of the students came from lower socioeconomic backgrounds. It is impossible to say what the outlook would have been for these students without the intervention of the summer program.

Recommendations

From a teaching perspective, research suggests that summer school programs need to be rigorous and yet fun for students. The curriculum should be very specific and individualized for each student whenever possible, but it should be encountered in an active, hands-on way that allows students to be fully involved in their own learning experiences. It should be tied to the school year curriculum and yet be approached in different ways to reach as many different learners as possible. There should also be testable goals that would allow teachers and students to track their progress. The school examined within the current study could compare the current practices of the summer school program to these research-based recommendations to ensure the best possible program for meeting students' academic needs.

Further study is required on the efficacy of various interventions, including summer school, for remediating summer learning loss and helping to narrow the achievement gap, particularly for middle school students. Past studies have focused either on elementary age interventions or on high school age interventions, with little attention paid to students in the middle. The current study should be replicated with larger middle school populations, including more diverse populations of students, to determine if the results of the current study also apply to other groups of students.

Future research should also attempt to more carefully control potential confounding variables. For example, summer school attendance records were not consistently kept for the charter school involved in this study. This could lead to data being included in the study for students who attended only one or two days of the program or who claimed they were going to attend but never did. This could skew the results toward a reduced impact of the summer school program. Replication of the current study with more careful summer school attendance records would greatly improve the accuracy of the results.

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