A Matter of Time: The Relationship of Class Length and Learning Theories to the SC Algebra I End-of-Course Test Scores in SC Middle Schools

By

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Abstract

For middle school students taking Algebra 1 as a high school credit, having sufficient instructional time is crucial. While the focus of the literature review helps lend understanding to the study, there has been limited information comparing academic growth in middle school math classes and the length of class time. Studies focused on Algebra 1 assessment performance normally pertain to high school students. Research on learning theory practices and how they affect student assessment in a middle school algebra class is also limited and is typically centered on specific subgroups within the classroom such as gender or ethnicity. A Spearman Correlation study design will be used to analyze the association of the End-of-Course Algebra 1 scores and class length among South Carolina middle schools. The scores from schools that offer Algebra 1 in the middle grades will be accessed through the state educational department accountability website. The class length time will be obtained through the school site information gathered from South Carolina Annual School Report Card information for each school and the individual school websites. Microsoft Excel® Data Analysis Add-on correlation will be used to analyze the quantitative survey data of time and test scores. A survey will be used to gather Algebra 1 teachers’ perceptions of learning theories implemented in their instructional practices. The learning theories included in the survey are: behaviorism, humanism, cognitive, critical theory, constructivism, and problem-based learning. The results of correlation from this study will be beneficial for administrators of middle schools in South Carolina, who are increasing the number of high school credit courses offered to their advanced students, as well as those who are exploring new scheduling options.
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Chapter 1: Introduction

Overview

Many studies have considered the length of high school class times both in relation to all offered courses and in individual disciplines, such as mathematics. Studies have considered length of middle school class time and middle level courses. Lorain (2015) noted: “Although most people believe that cognitive development plateaus in early adolescence, current research shows that young adolescents go through tremendous brain growth and development.” The amount of time needed for this growth must be considered in determining class length. For middle school students taking Algebra 1 as a high school credit, having sufficient instructional time is crucial during this formidable developmental time. One possible indicator of a student having sufficient instructional time is successful performance on the South Carolina End-of-Course (EOC) Algebra 1 test. As the EOC score comprises 20% of a student’s final algebra grade, it is important that students be given ample time for instruction. A thorough review of literature shows no relative model for middle school administration to use to make a reasoned and informed decision about the impact of the length of daily class time given for an Algebra 1 course relative to successful performance on the South Carolina EOC test. Another possible impact on successful performance on the EOC test that has not been explored is the learning theories teachers employ in their algebra instruction.

With those two research avenues in mind, this quantitative study explores two separate areas: the correlation between class length and middle school student scores on the South Carolina End-of-Course Algebra 1 test and a statistical study into the perception of learning theories teachers employ in their algebra instruction as it relates to performance on the South Carolina Algebra 1 End-of-Course test. An initial investigation
of research shows that a teacher’s educational philosophy affects the theory model used for classroom instruction. The instructor’s world philosophy, as an idealist, realist, pragmatist, or existentialist, filters down into their ideas for character development and general teaching methods. These methods reflect their educational philosophies (Cohen, 1999). This study will attempt to determine if there is a correlation between class time length and student test score results as well as explore the perceived teaching theories applied in these classrooms.

The literature related to this study spans the application of Algebra 1 as a middle school course, the historical aspect of class time length, and learning theories and their application in mathematics instruction. While the focus of the literature review helps lend understanding to the study, there has been limited information concerning assessment scores in middle school math classes and the length of class time. Studies focused on Algebra 1 assessment performance normally pertain to high school students. Research on learning theory practices and how they affect student assessment in a middle school Algebra class is also limited and is typically centered on specific subgroups within the classroom such as gender or ethnicity.

It is the intent of this study to determine a correlation between middle school score results on the EOC Algebra 1 test and class length time, as well as describe the perception of learning theories applied in these classrooms. The results of correlation from this study will be beneficial for administrators of middle schools in South Carolina, who are increasing the number of high school credit courses offered to their advanced students, as well as those who are exploring new scheduling options. Additionally, it will benefit parents deciding on their child’s educational options. The perceptions survey
results of this study will help bring awareness to the teacher’s perceptions of the instructional practices he or she applies in a South Carolina middle school Algebra 1 classroom so endorsement of actions or changes can occur.

**Statement of the Problem**

In the era of best practices implementation, there is neither consistent class time length nor one common instructional method used in a middle school Algebra 1 classroom. At the same time, there are more theories of learning in use in mathematics education research today than ever before (Lerman, & Tsatsaroni, 2004). Because of this plethora of applied learning theories, the accumulation of knowledge across theoretical perspectives proves difficult (Simon, 2009). South Carolina middle school schedules vary the length of their Algebra courses from 50 minutes to 90 minutes each day, for a full school calendar year (SCDE, 2003; SCOE, 2012). This variance is considered either a traditional schedule or a block schedule, respectively. When a school system makes decisions about which form of scheduling to use, informed decision makers should consider if the amount of time in class (class length) matters and what teaching theories are being implemented during the instructional time based on sound research.

According to Loveless (2013), instruction within a middle school algebra class should be applying learning theories that support successful results on the End-of-Course Algebra 1 test. The survey results of this study will show what learning theories are applied during instructional practices by teachers who are successful on the South Carolina EOC Algebra 1 test. A 2013 study by the Brookings Institute found that moving
Algebra 1 down into the middle schools resulted in lower EOC scores, causing fewer students to elect to take Algebra 1 (Loveless, 2013).

**The Research Problem**

Logic would dictate that expending more time for productive instruction would result in corresponding pronounced achievement levels. Current research into scheduled classroom time (class length) and best practices is limited – with a focus on the high school Algebra 1 courses or middle school subgroups. Research on teachers’ perceptions of the learning theories they apply in the Algebra 1 classroom indicates the focus is on subgroup performance rather than whole class results. Elmore (2002) notes: “The prevailing theory of learning suggests that teaching mathematics is not a developmental problem but a problem of aptitude” (p. 2). This idea demonstrates a need for an awareness of learning theories appropriate to the teaching of middle school algebra.

This dissertation intends to describe the various learning theories middle school Algebra 1 teachers believe they apply as the basis for their instructional methods. Though there are multiple learning theories, many of which are shoot-offs from earlier learning theories, the learning theories investigated for this study are six main theories commonly applied in a mathematics classroom and tied to the educational philosophies of perennialism, essentialism, progressivism, and reconstructivism (Greeno, 1997; Cohen, 1999; Boaler, 2001):

- Cognitive Theory
- Constructivist Theory
- Humanism
- Behaviorism
Critical Theory

Problem-based Learning

Further, this dissertation will seek to find a correlation between the length of an instructional class time and the results of student scores on the South Carolina End-of-Course test for Algebra 1. This is a two-part study because investigating a correlation between the length of instructional class time and EOC Algebra 1 test scores leads us into exploring what occurs within that time. Ultimately, by exploring these two areas of information, this quantitative study will attempt to endorse practices or promote change within South Carolina middle school Algebra 1 classrooms.

**Algebra in middle school.** Moses (2001) noted that “Mathematics education is a civil rights issue” In that same vein, Schoenfield (2002) pointed out that children who are not mathematically literate are not able to compete with their peers and are doomed to second-class economic status in our 21st Century world. Looking at mathematics through a civil rights perspective, the U.S. public school math curriculum design views the successful student as a “problem-solver” able to be an autonomous citizen adapting to the challenges that will be faced over a lifetime (Popkewitz, 2004, p. 18).

Higher education sees algebra as a gatekeeper course, requiring successful completion of the course in order to continue in a particular major or for graduation. Historically, selective subgroups have been excluded from this requirement with the presumption of the material being too difficult, leaving algebra for advanced students or those with the “gifted & talented” identifier (Rech and Harrington, 1999). Currently, all states require algebra, or its equivalent, as a graduation requirement. Many states are allowing students to meet this requirement early on, during middle school grades,
allowing them to acquire additional advanced mathematics credits in high school (USDE, 1997).

Algebra courses offered in middle school were once uncommon, as the class was generally considered a ninth grade course (Star & Rittle-Johnson, 2009). In 1990, 16% of middle school students nationwide were taking algebra. Over the last two decades, a substantial nationwide push for more students to take algebra in middle school has occurred (Loveless, 2008). Internationally, middle school-level students taking algebra were increasing at a rate much greater than in the United States. Reports supporting this increase led to a national push for students to take algebra by eighth grade (Loveless, 2008). The Trends in International Mathematics and Science Study (TIMSS), one such report, concluded that the United States eighth grade mathematics curriculum was equivalent to most seventh grade curriculum levels for other reporting countries (Greene, Herman, & Haury, 2000). As a result of this push for algebra instruction in middle school, the percentage of middle school students enrolled in algebra increased to 24% in 2000 and 31% in 2007. By 2008, more than half of middle school students nationwide were enrolled in an algebra course (Loveless, 2008).

An abbreviated history of school scheduling. The Carnegie Foundation for the Advancement of Teaching was established by industrialist Andrew Carnegie. In 1906, the foundation developed the Carnegie unit, or credit hour, which was used as a measure of the amount of time a student studied a given subject. One standard Carnegie unit is defined as one hour of instruction x 5 days a week x 24 weeks a year, or 120 hours overall of contact time with an instructor (Silva, White, & Toch., 2015).

This time-based unit was not designed as a measurement of student learning. The
unit was originally created as part of the admissions process for higher education participating in a free pension system for faculty, which was administered by the Carnegie Foundation for the Advancement of Teaching. The unit was used as a time-based measurement for university course offerings to determine levels of faculty workload necessary to qualify for free pensions. Filtering down from higher education, the Carnegie unit has become the primary representation for learning in American high schools (Laitinen, 2013).

High schools in America currently use this 120-hour standard to award course credit. A high school student typically earns seven to eight course credits per year over four years (Rettig, 2015). States vary in the minimum number of Carnegie units required for graduation. From the initial development of the Carnegie unit, determining the amount of necessary class time to maximize student achievement has been a focus of much debate.

Today, the most common class schedules in public schools are either the traditional periods or block scheduling. A traditional period day usually consists of 7 or 8 periods, 50-70 minutes in length. A block schedule day has 4 classes of 90-minutes each. With the emphasis on standardized testing, all school districts attempt to find what scheduling approach is most beneficial for students.

Over the last century, many viewpoints and theories have influenced class scheduling. Modern scheduling options were considered once the No Child Left Behind Act of 2001 came into play (Wraga, 2001). A great deal of research has been dedicated to class scheduling and its impact on American high schools, but a review of the research has found no studies that relate the same depth of investigation with class scheduling and
how it affects a middle school student’s performance on equivalent high school credit courses. Each schedule has its merits, and this quantitative study will attempt to explore the effect that scheduling in middle schools across the state has on student performance on the South Carolina Algebra 1 End-of-Course test.

An additional component of this study will be to examine the perceived instructional learning theories teachers apply in their algebra classrooms. This is a perceptual view by teachers which could lead to future additional qualitative research into actual observed practice of learning theory. When student test results come back lower than expected, in the analysis process teachers typically consider what outside influences could have occurred to give the negative result. The possible reasons often voiced are socio-economics, motivation, educational aptitude, and time (Meece, Parsons, Kaczala, Goff, & Futterman, 1982). This study will examine the correlation of time as a plausible reason for score results. A description of learning theories that teachers believe they are applying in their algebra classrooms will also be shown. This statistical research can be used to further investigate teacher learning theory instructional practices correlating to score results.

Middle school scheduling research focuses mainly on the advantages and disadvantages of modeling middle school schedules after their high school counterparts. Possibly due to the relatively new increase in the amount of Carnegie unit classes being taught in the middle schools, little research has been published on the effects of scheduling and success on End-of-Course testing for middle school students taking these advanced courses. If research demonstrates that there is no correlation between End-of-Course Algebra 1 score results and the time in the middle school class, educators will be
able to look at additional viable reasons behind their students’ performance on the test.

**Purpose of This Study**

The purpose of this quantitative, correlational study is two-fold. First, the study will examine the association between class scheduling and students’ performance on the End-of-Course testing in the area of Algebra 1. All middle school students in South Carolina who are taking Algebra 1 for high school credit are required to take the Algebra 1 End-of-Course test. Teachers are required to instruct all students according to state content standards in an effort to fully prepare them for the End-of-Course assessment. This study is intended to determine if class length has any correlation with the South Carolina Algebra 1 End-of-Course assessment results for middle school students.

Secondly, this study will seek to describe teachers’ perceptions of the learning theories applied in their class instructional time. In addition to the research examining a possible correlation between the length of class time and a student’s performance on the End-of-Course test, implemented instructional learning theories provides potential for further research to investigate learning theory implementation for test results. The results of this study could possibly be beneficial to administrators of middle schools in South Carolina who are increasing the number of high school credit courses offered to their advanced students and exploring new scheduling options, or for parents deciding on their child’s schooling options such as mainstream public schools, virtual schools, magnet schools, and charter schools.

**Research Questions**

1. Is there a correlation of student scores on the Algebra 1 End-of-Course test and
class length among South Carolina middle schools?

2. What learning theories do South Carolina Algebra 1 middle school teacher indicate influence their instructional practices and how does that relate to their Algebra 1 EOC test score results?

**Null hypothesis for research question #1:** There is no correlation of student scores on the South Carolina Algebra 1 End-of-Course test and class length among middle schools.

**Theoretical Context and Framework**

Learning theories help in describing teacher and student actions. Because there are a variety of learning theories, and theories are research tools, it can be difficult to determine which would be best or most effective. If a hypothesis or theory is continually confirmed, it gains strength and value (Hergenhahn, 1976). Hergenhahn presumed that “learning is a relatively permanent change in behavioral potentiality that results from experience…” (p. 9). Hergenhahn further noted that a theorist must determine the kind of experience and instruction taking place necessary for learning to occur. This study will be grounded in the context of Hergenhahn’s (1976) definition, as it relates to learning theories of Cognitivism, Constructivism, Humanism, Behaviorism, Critical Theory, and Problem-based learning.

**Cognitive Learning Theory.** Using Bloom’s (1956) research as a foundation, cognitive learning theory in the mathematics classroom is defined as the recollection or acknowledgement of knowledge and the development of intellectual abilities and skills. Bloom’s taxonomy of learning objectives discerns the difference between knowledge and intellectual abilities. Mathematical knowledge is the ability of a student to recall specific
information, processes, and/or patterns. Intellectual abilities are specific techniques to solve problems. Mathematical comprehension and application represent the more concrete methods. According to Bloom, abstract methods involved analysis, synthesis, and evaluation (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956).

**Constructivist Learning Theory.** The idea behind choosing appropriate class time lengths is often believed to be based on Piaget’s social development theories centered in constructivism and social constructivism. Jonassen (1994, p. 35) noted eight characteristics which underlie the constructivist learning mathematical environments:

1. Provide multiple representations of reality.
2. Give multiple representations for the complexity of the real world.
3. Emphasize knowledge construction instead of knowledge reproduction.
5. Provide learning environments with real-world settings and case-based learning instead of predetermined sequences of instruction.
7. Enable context- and content-dependent knowledge construction.
8. Support collaborative construction of knowledge through social negotiation, not competition among learners for recognition.

These characteristics lead to the idea that mathematics classroom time should be organized so the greatest possible amount of conceptual learning can occur in the given amount of time. Further, a social constructivist type of mathematics classroom allows for an active learning paradigm with learner-centric collaborative learning (Lewis, Dugan,
Winokur, & Cobb, 2002, p. 37). Although constructivism follows a socially constructed, or hermeneutic view of causation, post-positivists approach this type of study in a quantitative manner, which lends itself well for a mathematics class. According to Creswell (2014), “We cannot be positive about our claims of knowledge when studying the behavior and actions of humans” (p.7). Because of this mindset, post-postivists incorporate numerical representations of findings. By using the post-positive approach of identifying and assessing the cause of particular outcomes, this study may be able to determine if schedule type (class length) has any effect on the South Carolina Algebra 1 End-of Course results for middle school students.

**Humanism.** Humanist learning theorists believe in an approach to education based on the work of humanistic psychologists such as Abraham Maslow, Carl Rogers, and Rudolf Steiner, the founder of Waldorf education. In humanistic learning theory practices, the whole person in addition to intellect is engaged in growth and development in pursuit of real learning. The whole person involves the emotions, the social being, the mind, and the skills needed for a career direction (Rogers, 1969). “Humanistic mathematics is a philosophy of teaching and learning which attempts to explore the human side of mathematical thought and to guide students to discover this beauty of mathematics (Tennant, 2002, p. 1).” Humanism in the mathematics classroom involves interdisciplinary connections between mathematics and other worlds of thought and methods of learning such as visual imagery, 3-D models, and graphics (Tennant, 2002).

**Behaviorism.** Behaviorism was the predominant theory of learning from the 1950s through the 1970s, giving rise to use of empirical, quantitative studies of learning. Behaviorists believe that learning occurs through the observable interactions of the
learner with the environment, without surmising any internal conflicts within the learner. Behaviorism generates from the stimulus-response model of B. F. Skinner. Skinner believed that learning could be managed by affecting the variables of the situation, the behavior, and the results of the behavior (Bell, 1978). This stimulus-response theory is prescribed to by those who want to “exercise” the brain. Using drill and practice techniques, behaviorists believe repetition builds a strong foundation (Tipps, Johnson, & Kennedy, 2011). Directed instruction, where the teacher is providing the knowledge to the students directly or through contingencies is another example of behaviorist instruction (Forrester, D.; Jantzie, N., 1998). Computers first filtered into classrooms in the 1970’s and 1980’s when behavioral theories were the educational trend. Programmed Instruction, the creation of educational software, is based on behavioral learning theory. Though the technology used in the classroom was not part of the vision when Skinner developed his theory of learning, through the computer games students’ play, the underlying theory remains (Maddux, C. D.; Johnson, D. L.; & Willis, J. W., 1997).

Behaviorism, as a commonly-named theory, may have faded from common learning theory descriptions, though some teachers still apply its principles for instruction as “…its key notions are still alive and active in the minds of many educators” (von Glasersfeld, 1995, p. 178). A

Critical Theory. Critical Theory/Reconstructivism is associated with the work of Kant, Hegel, Marx, Weber, Lukacs, and Freud (Held, 1980). Critical theorists in the mathematics classroom use critical thinking skills, inquiry, question-asking, and actions as teaching strategies. Students learn to handle conflict and to recognize multiple perspectives. Critical Theory is “…self-reflective in its nature and value driven. The
ultimate goal of the Critical Theory is to transform our present society into a just, rational, humane, and reconciled society” (Jensen, 1997, p. 1).

**Problem-based Learning.** Problem-based learning (PBL) is as a learning method for mathematics that involves student centered learning in small groups lead by a tutor or “expert” rather than teaching using traditional lecture teaching (Barrows, 1996). The teacher is the facilitator of learning, guiding the students toward solution discovery on their own rather than simply providing the answer. The facilitator motivates the students’ cognitive learning process and problem-solving skills with self-directed learning (Armstrong, 2012). According to Dejan Bokonjic, (2009) and Henry Egidius (1999), there is a seven-step method for PBL practice which is to be followed when working with PBL. (a) clarifying terms; (b) defining the problem; (c) brainstorming; (d) structuring and hypothesis; (e) learning objectives; (f) searching for information; (g) synthesis.

Though there are many defined learning theories, the six chosen for this study have a strong basis in both the middle school classroom and mathematics. The theories blend into the two perspectives of the behaviorist (behaviorism and humanism) and cognitivist (cognitivism, constructivism, and critical theory). The behavioral learning theories design approaches for higher-order learning tasks or for transfer of learning with a structured, deductive approach to mathematical applications can lead to rapid acquisition of basic concepts, skills, and factual information within a clear framework with a connection to cultural and societal needs (Atkins, 1993). Cognitive learning theories applied in mathematics uses instruction with direct involvement in games, and simulations with immediate results. Students analyze, synthesize, summarize, describe, and solve problems using a variety of information sources for learners to alternate
between symbolic representations of phenomena and the real-life situation (Atkins, 1993). Both of these perspectives are also a part of the situative perspective framework, which includes problem-based learning as the use of technology in the mathematics classroom increases, focusing on the activity that constructs meaning (Greeno, 1997).

**Delimitations of the Study**

This study does not focus on middle schools across the nation but only public middle schools in South Carolina. This focus group of schools and limited singular state testing allows the study to fill a gap in the research found on state End-of-Course testing in South Carolina specifically. This research on the single End-of-Course test in Algebra 1 represents a focus on the recognized gatekeeper course for high school mathematics courses in the United States (USDE, 2010). As research has shown, in order to convey readiness for advanced math courses, both college-prep and technical-oriented, students require a basic knowledge of algebra (Levy, 1996). Algebra is considered as having “… a ‘gatekeeper’ role within the continuum of high school math courses – that it must be taken and passed by any student who aspires to take calculus or other advanced mathematics” (Adelman, 1999, p. 2).

**Limitations of the Study**

A Likert scale with ratings from strongly disagree to strongly agree will give quantitative results of the teacher perception survey. These results will be based on the assumed honest answers of teacher participants. This study’s focus is with South Carolina public schools rather than all possible South Carolina middle schools due to the readily available data information from the State Department of Education, allowing for a research analysis of students the department serves. This study considers class time, End-
of-Course results, and reported instructional practices and philosophies, not demographics of students or teacher experience levels as causation for student EOC scores.

**Summary of Methodology**

The research will use a quantitative, non-experimental Spearman Correlation approach to examine the association between class scheduling and the performance on the End-of-Course testing in the areas of Algebra 1 / Math for the Technologies. The statistics research will also include a survey in a Likert-scale format for examination of teacher learning theories applied during their instructional practices in the Algebra 1 classroom.

**Definition of Terms**

**Carnegie unit.** Standard instructional measure, defined as 120 clock hours of instructional seat time for a high school credit course (Martinez & Bray, 2002).

**Scheduling as defined by the South Carolina Board of Education (2003):**

**Block scheduling.** Generally, four 90-minute periods each school day for a full calendar school year. Table 1 demonstrates the typical block scheduling used in public South Carolina middle schools.

Table 1.

**Block Schedule.**

<table>
<thead>
<tr>
<th>Block Time</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-90 minutes</td>
<td>Language Arts</td>
</tr>
<tr>
<td>85-90 minutes</td>
<td>Mathematics</td>
</tr>
</tbody>
</table>
85-90 minutes & 85-90 minutes
Science/Social Studies & Elective Course 1 & 2

**Alternating or A/B scheduling.** A 90-minute period schedule. Classes meet every other school day for a full calendar school year. Table 2 shows a typical alternating or A/B schedule used in public South Carolina middle schools.

Table 2.

*Alternating or A/B Schedule.*

<table>
<thead>
<tr>
<th>Day Schedule</th>
<th>A Day</th>
<th>B Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>85-90 minutes</td>
<td>Course 1</td>
<td>Course 2</td>
</tr>
<tr>
<td>85-90 minutes</td>
<td>Course 3</td>
<td>Course 4</td>
</tr>
<tr>
<td>85-90 minutes</td>
<td>Course 5</td>
<td>Course 6</td>
</tr>
<tr>
<td>85-90 minutes</td>
<td>Course 7</td>
<td>Course 8</td>
</tr>
</tbody>
</table>

**Traditional schedule.** A school day divided into seven or eight periods, generally of 50 to 70 minutes each for a full calendar school year. Table 3 shows a typical traditional schedule for public South Carolina middle schools.

Table 3.

*Traditional Schedule.*

<table>
<thead>
<tr>
<th>Period Times</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 1</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 2</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 3</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 4</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 5</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 6</td>
</tr>
<tr>
<td>45 minutes</td>
<td>Course 7</td>
</tr>
</tbody>
</table>

**South Carolina End-of-Course test (EOC).** The test administered to all South Carolina High School students to determine their mastery of the academic standards as set forth by the South Carolina state department of education (South Carolina Department of Education, 2008).

**Gifted and talented.** Gifted and talented students are those who are identified in grades 1-12 as demonstrating high performance ability or potential in academic and/or artistic areas (South Carolina Department of Education, 2008).

**School choice option.** Due to legislative decree, South Carolina students have the following options when choosing a public school setting:

Public charter schools

Virtual charter and magnet schools

Middle and early college programs

Single gender programs

Montessori schools
Military schools

Year-round schools

Career and vocational centers

**Middle Schools.** South Carolina has 365 public schools that house grade levels that include at least one of the typical middle grade levels of 6-8th grade.

**Conclusion.** The purpose of this quantitative correlation and inferential survey study is to examine the association of scores on the Algebra 1 End-of-Course test for South Carolina middle school students and the teacher’s perceptions of applied learning theories. Chapter 1 introduced the problems of the algebra gateway course and the lack of sufficient research available at the middle school level to endorse practices or promote change within South Carolina middle school Algebra 1 classrooms. The chapter detailed the research plan for conducting a quantitative correlation study and an inferential survey study, involving data from the state department of education and survey results. The chapter also demonstrated the significance of the study, the contributions of the theoretical framework with six learning theories: behaviorism, humanism, cognitivist, constructivist, critical theory, and problem-based learning, and presented an overview of the research study. Chapter 2 presents a review of past literature related to the research questions. This chapter explores the available research relevant to middle school schedules and the correlation to student academic success on End-of-Course mathematic assessments.
Chapter 2: Literature Review

Overview

This review is divided into five components: (a) middle school students and development; (b) research attributed to the offering of Algebra 1 in middle school; (c) school scheduling history and research; (d) scheduling related to End-of-Course achievement levels in South Carolina; (e) learning theory applied in the mathematics classroom. This research explores the relationship connections of these five components to the available research relevant to middle school schedules and the correlation to student academic success on End-of-Course mathematic assessments.

Middle school students and development. At the middle school age, young teens experience many physical and emotional changes, as well as advances in their cognitive abilities. While younger children's thinking focuses on concrete, observable events, adolescents begin abstract thinking and hypothetical-deductive reasoning. Middle school aged children are able to develop hypotheses and then systematically deduce, or conclude, a best strategy for a solution to a problem. Adolescents experience improvements in their metacognitive skills and are able to employ strategies to assist them in information recall and to explain to others the cognitive strategies that they are utilizing (Keating, 1990).

One idea behind why adolescents experience these improvements in their metacognitive skills during this time frame is due to the brain changes from ages six to twenty (Giedd, 2004; Giedd, et al., 2006; Sowell et al., 2003). These changes involve the brains neurons, which transmit the information between the body and the brain. This information is transmitted through neurotransmitters, a chemical that transfers the
information in the gaps, or synapsis, between the neurons (Steinberg, 2005, p. 69). Information that is no longer needed, such as a temporary burning sensation, is removed by synaptic pruning (Blakemore & Choudhury, 2006; Giedd, 2004). Both the pruning and myelination, the white matter in the brain, which increases the speed of the transmitting impulses change during adolescence (Steinberg, 2011, p. 71). The pruning and myelination increases in efficiency during adolescence, resulting in cognitive changes that include increased information processing, planning, hypothetical and abstract thinking skills, and deductive reasoning (Steinberg, 2005; Steinberg, 2011; Spear, 2010).

The cognitive development does not occur at the same rate for all adolescence and other areas of the brain continue to change, such as the prefrontal cortex, limbic system, amygdala, and the hippocampus (Steinberg, 2011; Yurgelun-Todd, Killgore, & Cintron, 2003). The prefrontal cortex is the brain’s thinking, impulse control, attention, and reasoning area. The limbic processes emotions, socialization, and results (Casey, Jones, & Hare, 2008, Geidd, 2004; Steinberg, 2011). Due to the slower developmental rate of the prefrontal cortex at this age, the limbic system growth results in adolescent risk and challenging behaviors (Geiger & Luna, 2009). The amygdala ties in with the limbic system, with emotional learning and fear experiences. The hippocampus regulates emotions, memory, and learning (Caskey & Ruben, 2007). This constant growth and change leads many of the behaviors of a middle school student. Because the brain growth cycle occurs at different times and adolescents progress through it at different rates, their instructional needs will vary. Some students will be ready for problem-solving activities, while others may still be working at their best when dealing
with concrete information. “Given these facts and the fact that students learn in different ways and respond to different stimuli, the direction is clear: The middle school classroom should be an active, stimulating place where people talk and share, movement is common and planned for, and the teacher uses a wide array of approaches to introduce, model, and reinforce learning” (Lorain, 2015, p. 1).

For middle school aged students, the early teen years is a time of intense physical growth, with the rate of development varying for each individual (Alexander et al. 1968; Carnegie Council of Adolescent Development, 1989). These physical changes are a result of the developmental growth in the endocrine system which produces and regulates hormones, and the central nervous system (Alsaker & Flammer, 2006, Steingberg, 2011). Sexual characteristics and changes in the reproductive system are occurring during this time of puberty (Alsaker & Flammer, 2006). Adolescents will exhibit rapid physical growth in the heart size, lung capacity, weight, height, muscular strength, and body mass (Alsaker & Flammer, 2006; Dahl, 2004). Genetics, nutrition, and health care play a role in the developmental rate of these changes, with girls generally beginning the transition a bit sooner than young boys (Alsaker & Flammer, 2006; Carnegie Council of Adolescent Development, 1989). These physical changes, with gangly and awkward bodies will result positive, negative, beneficial, or detrimental and risky responses (AMLE, 2010; NMSA, 2003). Sleep patterns may change during puberty (Steinburg, 2011). Emotional and psychosocial development can be affected by these physical changes (Dahl, 2004; Steinberg, 2005; Yurgelun-Todd, 2007).

Puberty and adolescence affects the areas of brain that address sexual and romantic interests, emotional intensity, risky behavior and reward seeking activities
(Casey, Jones & Hare, 2008; Dahl, 2004; Forbes & Dahl, 2010; Steinberg, 2005; Steinberg, 2011). These areas mature earlier than many areas of cognitive developmental areas, such as judgement, impulse control, and decision making (Casey, Jones, & Hare, 2008). Adolescents are seeking their identity leading to emotional responses, sensitivity, and influence (Lounsbury, 2011). This is a time of both positive and negative influences, where students can become passionate with commitments, art, sports, music, and hobbies (Dahl, 2004). This is an age when adolescents need assistance for regulation and self-control, or guidance through behavioral and emotional problems (Dahl, 2004). Social development becomes important during this age (Lounsbury, 2011). The connections of the physical, cognitive, and emotional changes, which begin at different times for individuals lead to the premise of the middle school, to act as a bridge that focuses on the unique developmental characteristics of the middle school child, providing the instruction that compliments these developing characteristics (Alexander, 1968; Eichhorn, 1966, Echhorn, 1967).

**Research attributed to the offering of Algebra 1 in middle school.** A push in the 1990s by the United States educational leaders encouraged the increase in the number of middle school students taking algebra before high school. As an additional motivator, Robert Moses labeled algebra as “The New Civil Right,” emphasizing the social consequences of so many poor and minority students taking remedial and general math courses instead of algebra (Lacampagne, 1995). Founded in 1905, the Carnegie Foundation for the Advancement in Teaching issued a report defining a term of instruction as “a course of five periods weekly throughout an academic year” (p. 81). This instructional time period, accumulated over the course of a school year, was called a
Though the construction of the Carnegie Unit gave structure and continuity to the implementation of high school courses, the algebra course has been a part of the high school curriculum since the 1800s. The Committee of Fifteen, which was created by the National Education Association in 1895, made a recommendation that algebra be part of the seventh and eighth grade curricula (Ornstein & Hunkins, 2008). Though this was encouraged, most schools continued to keep Algebra 1 at the high school level until the late 1980s when several middle schools began offering the Carnegie Unit of credit as an option for differentiation for students identified as gifted and talented.

In 1997, The Secretary of Education, Richard W. Riley, stated in Mathematics Equals Opportunity that, "The key to understanding mathematics is taking algebra or courses covering algebraic concepts by the end of the 8th grade. Achievement at that stage gives students an important advantage in taking rigorous high school mathematics and science courses” (United States Department of Education, 1997).

The report, National Excellence: The Case for Developing America’s Talent by the United States Department of Education (1993), made comparisons with educational opportunities offered to gifted students and those in other developed countries. The Pre-K-Grade 12 Gifted Program Standards, published in 1998 by the National Association for Gifted Children, gave guidelines for schools creating programs to serve the gifted and talented (Matthews & Shaunessy, 2010). Although there have been numerous studies relating course scheduling times and the achievement of high school students taking mandated End-of-Course assessments, no known research has been done at the middle school level for students taking the Carnegie unit courses. A Nation Deceived: How
*Schools Hold Back America’s Brightest Students*, published in 2004 by Iowa University, examined the benefits of accelerated learning for gifted students (Colangelo, Assouline, Gross, & Iowa University, 2004).

In 2006, President George W. Bush established the National Mathematics Advisory Panel with the goal to investigate the state of mathematics in America (Executive Order, 2006). The Panel’s *Reports of the Task Groups and Subcommittees* emphasized algebraic thinking in early education, with a major goal of developing “Critical Foundations of Algebra” skills during the K-8 years (United States Department of Education, 2008).

An earlier study by the US Department of Education (2000) found that students who complete high school math courses beyond Algebra 1 have increased chances of earning a bachelor’s degree (USDE, 2000). As a gatekeeper, Algebra 1 allows students to complete more of the necessary math courses and puts them in a better position for earning a college degree. In 2009, high school graduates who took Algebra 1 in middle school scored 31 points higher on the National Assessment of Educational Progress (NAEP) mathematics assessment than graduates who took Algebra I as their first high school math course (USDE, 2010). In an attempt to even the playing field with international competition for STEM (science, technology, engineering, and mathematics) careers, middle school students need the opportunities that taking Algebra 1 allows. The offering of the high school credit course in a middle school program leads to questions of how best to schedule the advanced program.

**School scheduling history and research.** Largely, scheduling has been influenced by social development theories centered in constructivism. Creswell (2014)
Social constructivists believe that individuals seek understanding of the world in which they live and work. Individuals develop subjective meanings of their experiences—meanings directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas. (p. 8)

The constructivist theory model is based on the theories of psychologists such as Jean Piaget and Lev Vygotsky (Hackman, 2004). Vygotsky believed students developed through engagement with consistent and systematic inquiry (Zuckerman, Chudinova, & Khavkin, 1998). Social interaction was a necessary component of inquiry used to internalize the instructional material (Eun, 2008). To engage in metacognition and real world problem-solving, students needed the time to learn. With the emphasis on depth of understanding, rather than surface learning, constructivist educators are encouraged to be learning facilitators (Hackman, 2004). The constructivist theory can be used in considering optimal student class time, as well as the amount of time necessary to cover the required concepts and state standards. In turn, the amount of instructional interaction leads to decisions about the length of class instructional time.

Looking at school scheduling further back in history, the 1950s brought great concern that America was falling behind in rigorous, competitive courses. The launch of Sputnik in 1957 by the Soviet Union, and then a second launch, was enough to push education and school reform to the forefront of government policy. America went through an educationally innovative period of reform after the launch of Sputnik (Conant, 1959).

With The National Defense Education Act (NDEA) of 1958, mathematics,
During the 1960s and 1970s, one of the changes in schools dealt with school scheduling. Dr. J. Lloyd Trump, a professor at the University of Illinois and the Associate Director of the National Association of Secondary School Principals, advocated for change and innovation in the organization of the school day. One of his proposals was to move away from the traditional schedule and examine the idea of classes of varying lengths (Queen, 2000). The Trump Plan, as it became called, encouraged schools and teachers to use different instructional strategies with varying amounts of student class time. Class time was built around 20-, 40-, and 60-minute intervals and sections of school days were blocked out for student independent study, small group collaboration, and whole group instruction. Due to the large amount of variance, the schedule format did not survive, but it did open doors for new scheduling opportunities. New reform initiatives promoted alternatives to the traditional schedule to utilize educational time (Rikard & Banville, 2005).

On the heels of the 1950s, 1960s, and 1970s, during the 1981-1982 school year, the Association for the Evaluation of Educational Achievement (IEA) conducted a study of mathematical achievement for twelfth-grade students in 12 countries. Six topics – number systems, sets and relations, algebra, geometry, elementary functions and calculus, and probability and statistics – were assessed. Hong Kong students scored highest, Japan students were second, and the United States ranked last among advanced industrial countries (McKnight, 1987). With great concern over the state of the country’s educational system, Secretary of Education Terrel H. Bell, under President Ronald
Reagan, created the National Commission on Excellence in Education. The commission found that achievement levels on standardized tests for high school students had dropped since the 1950s. Both the negative results of the study and public reaction prompted the National Commission on Excellence in Education to issue the report, *A Nation at Risk* (National Commission on Excellence in Education, 1983). Included in the report were comparisons of the amount of course time students in America spent and schools in nations with successful educational results as measured from 19 academic tests. The time spent on mathematics courses in the higher-ranked, industrialized countries, based on class hours, averaged about three times longer than time spent in American high schools. The report encouraged schools to implement new pedagogical methods for engaging students and facilitating new ways of learning (National Commission on Excellence in Education, 1983).

American students’ typical calendar contained 180 school days, with about six hours of instructional time. In other countries, students were spending eight hours a day, 220 days a year, learning. Time spent on core subjects was also shorter in U.S. schools (National Commission on Excellence in Education, 1983). This report led to educational reform, with a major component related to school scheduling and investigating the benefits of traditional vs. block scheduling (Stanley et al, 2007).

Published in 1989 by *Turning Points: Preparing American Youth for the 21st Century*, the Carnegie Council on Adolescent Development’s Task Force on Education of Young Adolescents produced a report focused on the structure of middle schools. The Council (1989) determined that middle school students were in a transitional phase of development, in cognitive, emotional, and physical growth, which prompted decisions to
be made about their instructional well-being. This report led to the incorporation of block scheduling into many of the middle schools across America. As a reminder, block scheduling is defined as class instructional time generally lasting about 90 minutes.

In the 1990’s, under The Education Council Act of 1991, the Secretary of Education, Richard W. Riley, under President Bill Clinton, created The National Education Commission on Time and Learning (NCTL). The Commission published the report, *Prisoners of Time*, which had educators focusing on school scheduling and academic course structure as ways to build success (Stanley, Spradlin, & Plucker, 2007).

The commission report noted: “The reform movement of the last decade is destined to flounder unless it is harnessed to more time for learning (NECTL, 1994). Educators were encouraged to stretch their thinking toward new ways to structure the student’s academic day. The reports *Prisoners of Time* and *A Nation at Risk* resulted in turning points in the national educational system and were instrumental in the reform movement throughout America, as educators began to look at alternative schedules, such as block scheduling and alternative day schedules, and the effects on student learning (National Education Commission on Time and Learning, 1994).

As the commission noted, there are two main types of schedules, the traditional period day and the block schedule. A traditional period day consisting of 6-7 periods with approximately 50 minutes per period, has been in existence within American schools since the Industrial Revolution. With the rise of capitalism, the average American needed more education to take advantage of economic opportunities. Prior to the revolution era, students in American schools spent less than half of their year in school. Family farms or supportive jobs prevented regular attendance. After the transition into the industrial age,
the typical educational curriculum, focused mainly on memorization, was found to be lacking as a best practice (Barlow, 1967). A new system introduced in 1835, the Prussian system of normal schools developed by J. H. Pestalozzi, recommended more “hands-on” activities. Pestalozzi stressed the importance of meaningful experience to create productive people (Smith, 2002). This move toward implementing activity-based instruction increased the focus on the length of class time needed.

The second type of scheduling, the block scheduling option, came into use in the 1980s (Williamson, 2009). A block schedule typically consists of four, 90-minute classes per day (Queen, 2008). The Copernican Plan, developed in 1983 by Joseph Carroll, proposed a move toward longer blocks so teachers could individualize and differentiate instruction (Carroll, 2005).

There are advocates for both the traditional and block forms of scheduling. Some teachers believe block scheduling allows for stronger teacher-student connections (Flannery, 2008). There is also the belief that the increase in time from block scheduling allows for more in-depth learning as well as higher teacher and student confidence in learning (Imbimbo & Gilkes, 2008). Rettig and Canady (1995) reported that teachers claim block scheduling allows them to plan extended lessons with various instructional strategies for individual learning styles.

In a 1996 letter quoted in the research by Jeff Lindsay, Dr. Frank Y.H. Wang, President of Saxon Publishers states: “If you are considering a block schedule, we suggest you do not. We believe that children learn most effectively when they are exposed to concepts in small, easily understandable pieces called increments and when new concepts and skills are reviewed continuously. This pedagogical philosophy
supports the idea that two or more opportunities to study the same material are much more effective than a single opportunity (Lindsay, 2008).

Research has shown both positives and negatives for block scheduling and for the long-standing traditional schedules (Lewis et al., 2005). A 1986 study by Raphael and Wahlstom of 80 schools in Canada found that students on block scheduling scored significantly lower on the Second International Mathematics and Social Science assessment (SIMSS) than students on a traditional schedule. They also found that science scores were higher in schools with traditional schedules (Raphael & Wahlstom, 1986). In their research, however, Rickard and Banville (2005), noted that the perception that block scheduling has an effect on achievement is inconclusive. In that same vein, Hickmann (2004) found that there is little theoretical basis behind block scheduling and limited research proving a correlation with student achievement. A 1995 study of Algebra 1 and Geometry students in Alabama found no difference in test scores for block or traditional schedules (Lockwood, 1995).

Inconsistent results in previous studies with high school students leave questions related to developmental stages or learning theories. Additionally, a lack of available research for school scheduling related to Algebra 1 achievement and middle school leaves a gap in developmental-level or learning theories studies.

**Scheduling related to end-of-course achievement levels in South Carolina.**

South Carolina uses the Algebra 1 course as the benchmark course for math advancement. Students who take either Algebra 1 (honors, college prep level, or Algebra 1A and IB), or its equivalent of Mathematics for the Technologies 1 & 2, are required to be successful in this course before moving on to the next mathematics course. Although
there is limited research data on scheduling and End-of-Course scores in South Carolina, there have been studies on scheduling and the score results using other assessments, such as Advance Placement scores, SAT scores, and GPA. In 2003, the South Carolina State Board of Education conducted a study using data from the 2001-2002 high school report card variables of assessment forms and the various high school schedules available. The data analysis showed that schools with traditional schedules performed better on Advanced Placement and SAT assessments than schools with alternative or block scheduling (South Carolina State Board of Education, 2003). Another study attempted to investigate block scheduling in South Carolina high schools. The study investigated four years of SAT data for seven high schools that followed a block schedule. The mathematics score results on the SAT were inconclusive, though the verbal performance demonstrated an increase in scores with block scheduling (Owings, 2001).

A study of GPAs of the 1995 class of Algebra 1 students with traditional scheduling and the 1999 class of Algebra 1 students at one school with block scheduling were compared. The findings showed an increase in the mathematics GPAs for the block scheduling classes (Hughes, 2004). With this study, limitations of different grading scales from the two different school years resulted in the use of a grade adjustment measure in order to compare the data, as well as demographic changes which could have resulted in an elevated result.

A 2010 research study using three high school schedules, the block, alternate A/B, and traditional, and the South Carolina High School Assessment Program (HSAP), found no significant differences in the mean ELA and math passage rates among the three types of schedules (Norton, 2010). A 2012 causal-comparative study investigated the
differences in the 2006 End-of-Course Examination Program (EOCEP) test scores of ninth grade students in English I and Algebra 1 / Math for the Technologies and the influence of class scheduling. The results of the study showed no significant differences in scores (Howard, 2012).

A 2012 study of schedules and scores on the South Carolina End-of-Course test for Algebra 1 using students from three consecutive freshman classes of block schedules and three from traditional schedules found a relationship existed between student scores on the South Carolina Algebra 1 End-of-Course test and the type of schedule used. Students on a traditional schedule had higher scores on the assessment than block scheduled students (Lancaster, 2012).

Again, there is inconsistency in class time and results for high school students in South Carolina taking the EOC test for Algebra 1, just as there was in national research. By focusing on a singular state, this study will attempt to gain an understanding of what is a possibly a consistent, common factor in EOC Algebra 1 testing results.

Learning theory applied in the mathematics classroom. Thirty to forty years ago, the students typically taking Algebra 1 in middle school were those identified as gifted and talented. This was also a time when learning theories related to the way students learn became a “latest fad” in education (Shuell, 2013). Though this research covered many aspects of the gifted student, shortfalls have occurred in the instructional learning theory for this subgroup of mathematics students. For example, the National Mathematics Advisory Panel noted that there are minimal numbers of studies, many of which are more than ten years old, that examine the cognitive processes underlying mathematically gifted students' learning (USDOE, 2008). Though these studies built a
foundation for middle school teachers in their beginning years of teaching algebra, there is a need for updates and new information now that algebra in the middle school has become so common that a higher percentage of these students are not identified as gifted (USDOE, 2008). The amount of new information available is limited. In fact, the number of articles related to algebra instructional practices in the NCTM journals has gone from 275 in the 1970s to less than 40 in this new century (Sochia, 2006).

The National Mathematics Advisory Panel’s final report of 2008 included a chapter on instructional practices. Their focus was not so much a focus on learning theory but on the then-current controversial issue behind teacher-directed or student-centered instruction (NMAP, 2008). Additionally, within these types of instruction, the actual applied learning theory that uses teacher-directed or student-centered instruction as its tool is not investigated.

Current research for instructional practices in algebra center on the constructivist theory as the ideal instructional theory behind mathematics learning. Mathematical teaching practices recommended by the NCTM Standards (NCTM, 2000) are grounded in views of knowledge, learning, and teaching informed by a constructivist perspective (e.g., Brooks & Brooks, 1999; Davis, Maher, & Noddings, 1990; Fosnot, 1996). The singular focus from a national organization has limited the amount of research considering alternative learning theories that have potential for successful application in the mathematics classroom. Lorain’s description of a middle school classroom based upon brain and cognitive development describes a combination of theories that involve an active stimulating atmosphere with shared learning, movement, and multiple approaches to reinforce learning (Lorain, 2015).
**Conclusion.** The emergence of implementing Carnegie unit courses in middle and junior high schools during the 1980s occurred shortly before the increased focus of school scheduling by the American government and school officials. Though research has covered scheduling and middle schools’ general education courses, a review of literature has shown that there is a need for additional research investigating middle school Carnegie unit courses and scheduling. Sufficient high school studies have been performed but with mixed results.

Much has been written about school scheduling throughout the years, and its ties to general student achievement, at all grade levels, as an indicator of school climate. When we consider school schedules, student achievement, and teacher instructional practices, we are looking at segments of school climate. School climate has been found to be a large indicator of student success. The teacher’s perception of learning theory in relation to instructional practices for a middle school Algebra 1 class in South Carolina has not been examined and should be collected. The following study intends to add to current literature. The next chapter will explain the methodology of this research study.
Chapter 3: Methodology

Overview

This chapter presents an overview of the purpose for this study and describes the research design and methods used to conduct the study. It also includes information about the research questions, hypotheses, population and sample, instrumentation, procedures, and data analysis used in the study. The purpose of this quantitative correlation study was to examine the association between class scheduling and the performance on the End-of-Course testing in the areas of Algebra 1 / Math for the Technologies. This quantitative research will include a survey in a Likert-scale format for examination of teachers’ perceptions of learning theories applied during their instructional practices in the Algebra 1 classroom. The null hypothesis for the correlation study maintains that there is no correlation of student scores on the South Carolina Algebra 1 End-of-Course test and class length among middle schools.

Research Design and Procedures

This study includes a quantitative correlation of EOC Algebra 1 test scores and class length. This is an appropriate design when there is no manipulation of predictor variables and no interventions or treatments to the variables (Gay, Mills & Airasian, 2008). One difficulty with nonexperimental research is the lack of control over the predictor variables (Neuman, 2003), so “the truth of the hypothesized relationship between x and y cannot be asserted with confidence” (p. 559). A second problem in nonexperimental research is the effect of an uncontrolled extraneous variable that can influence the results of the study. Acknowledgement of these variables as limitations of this study increases the validity of suppositions developed by study findings. In
quantitative research, the researcher collects and analyzes numerical data to make
inferences based on direct observations or products of direct observations (Kerlinger &
Lee, 2000). The rationale for using a quantitative research design is described by
Creswell (2009) “the researcher tests a theory by specifying a narrow hypothesis and the
collection of data to support or refute the hypotheses” (p. 16).

Three hundred sixty-five public schools in South Carolina contain students in at
least one of the grades 6-8. The scores from schools that offer Algebra 1 in the middle
grades will be accessed through the state educational department accountability website.
The class length time will be obtained through the school site information gathered from
South Carolina Annual School Report Card information for each school and the
individual school websites.

The study also includes a survey designed for awareness of instructional theories
incorporated in the classroom matched with the EOC score results. Survey research is an
effective and efficient research method to gain inferential information (Creswell, Clark,
Gutman, & Hanson, 2003). A survey allows the researcher to collect a sizeable amount of
data from a large sample in a limited period of time in order to describe aspects of the
population such as attitudes, opinions, behaviors, or characteristics (Creswell, 2009). A
teacher perception survey (Appendix A) will be implemented and a quantitative analysis
of the mean scores from the EOC Algebra 1 test will be examined. The mean scores are
obtained from the South Carolina Department of Education website. An email of
explanation will be sent out to the principals of each school to use with his or her algebra
teachers introducing them to the Google form survey prior to the administration
(Appendix B). The ability to survey a large number of teachers in a quick and expedient
manner makes this method of survey administration the most effective in order to achieve the highest return of survey information.

An adequate research instrument was not available to measure the areas of teachers’ perceptions of scheduling and assessment results. Therefore, the researcher designed an instrument expressly for this purpose adapting resources from permitted instructional resources (Cohen, 1999; McMahon, 2000.; Moallem, 2003). The permission was granted through email communications with Drs. Cohen, McMahon, and Moallem (Appendix C). This instrument was developed based on an extensive review of the available literature. The survey will be distributed to doctoral-level professors for validation of the specific learning theories and for review, comments, and suggestions as to the adjustments and improvements needed in the research instrument. The survey will be pilot tested by middle school algebra teachers in seven school districts. The pilot survey link will be sent to the directors of Curriculum & Instruction in the district offices to be sent out to the principals of the middle schools for their mathematics teachers to take during the initial period of teacher workdays prior to the start of the 2015/2016 school year. Communication with the directors involved with Curriculum & Instruction of the upcoming survey has occurred through phone calls to the districts involved. The purpose of the pilot survey is to assess the collection of the feedback and the Excel analysis.

**Sample, population, or subjects.** Data will be analyzed from two sample groups: (a) all public South Carolina middle schools that offer Algebra 1 as a Carnegie unit; and (b) South Carolina public middle school mathematics teachers who also return the algebra teacher perception survey. As stated before, South Carolina has 365 public
schools which include at least one of the middle school grades of 6-8. Though each of these schools incorporate the middle grades, a segment of those schools will report they do not offer a high school credit algebra course. These schools will be phased out of the survey quickly by the structure of the survey and their results will not be part of the final results calculations. The population size for teachers will depend upon how many teachers are assigned Algebra 1 courses at their respective schools.

**Variables in the study.** The independent variable is class scheduling. The scheduling will be sectioned into: (a) Block (90); (b) Block A/B schedule; (c) Period (45-55); and (d) Period (70). This data will be obtained from the South Carolina Department of Education website and school websites. The dependent variable is the End-of-Course test scores (mean score) of middle school students taking the Algebra 1 Carnegie course. This data will be obtained from the South Carolina Department of Education website.

**Instrumentation and materials.** The South Carolina End-of-Course Algebra 1 test will be used for the continuous variable in the Spearman correlation. The South Carolina Education Accountability Act of 1998, and its revision in 2008, required the development of End-of-Course examinations in gateway, or benchmark, courses for high school grade levels. Currently, the following courses are considered gateway courses and are a prerequisite for the End-of-Course Examination Program (EOCEP: Algebra 1, Mathematics for the Technologies 2, English 1, Physical Science, Biology 1, Applied Biology 2, and U.S. History and the Constitution).

According to the South Carolina Board of Education Regulation 43-262.4, there are three purposes and uses of the EOCEP tests: (a) promote instruction in the specific
academic standards for the courses, encourage student achievement, and document the level of students’ mastery of the curriculum standards; (b) be an indicator of effectiveness for programs, schools, and school districts in the manner prescribed by the Education Oversight Committee in accordance with the provisions of the Education Accountability Act of 1998 (EAA); and (c) count as 20% of the students’ final grades for gateway courses.

The Likert-scale survey was created with resources provided by Dr. Joan McMahon (2000) from Towson University, Dr. LeoNora Cohen (1999) from Oregon State University, and Dr. Mahnaz Moallem (2003) from the University of North Carolina Wilmington. Drs. McMahon and Moallem gave permission to use their current educational program instructional material which addresses specific characteristics of the learning theories incorporated into this study. Their material was used to adapt a survey Dr. Cohen created in 1999 for her instruction on philosophies in education, which contained educational philosophies and learning theories (Cohen, 1999; McMahon, 2000.; Moallem, 2003). Though Dr. Cohen did not go through a process for validity of her survey, she has continued implementing the survey to her students taking her educational courses. The created survey was then sent out to graduate and doctoral-level professors at Gardner-Webb and personnel in a local middle school and district office who had terminal degrees in education, to validate the alignment of statements with the learning theories. This survey will be the instrument used to gather the learning theory segment of this study (Cohen, 1999; McMahon, 2000.; Moallem, 2003). Because a Likert scale refers to a summated score produced by a survey comprised of Likert-type items rather than to an individual item itself, this scale was appropriate for measuring attitudes
A Google forms survey will be created in a logic branch design. This format leads teachers into only choosing one county and one school to input their data. The questions used for each learning theory relate to the theoretical framework with responses on a scale from 1, "Strongly Disagree," to 5, "Strongly Agree" (Appendix A). The next part explains the learning theory constructs for the survey.

Using the context of Hergenhahn’s (1976) definition of learning theory in relation to learning theories of Cognitivism, Constructivism, Humanism, Behaviorism, Critical Theory, and Problem-based learning, the survey questions were matched for characteristics found in each of the theories. The instructional material on learning theories from Drs. McMahon and Moallem were used to add depth and direction to the phrasing of the statements aligned to each learning theory (McMahon, 2000; Moallem, 2003).

For cognitive learning theory, the foundation for the statements came from Bloom’s taxonomy and definition of cognitive learning theory (Bloom, 1959). Using this framework and the materials from Drs. Cohen, McMahon, and Moallem, the characteristics of cognitive learning theory included a curriculum based on student interest and needs, emphasizing experience and drive to reach the highest level of potential, based on taxonomy. Instruction included project-based, interdisciplinary subject matter, with student-driven differentiated learning and self-reflection (Cohen, 1999; McMahon, 2000; Moallem, 2003).

Jonassen (1994) incorporated Piaget’s social development theories for characteristics of a constructivist. The characteristics also involved an active learning paradigm with learner-centric collaborative learning (Lewis, Dugan, Winokur, & Cobb,
2002, p. 37) which lead to survey questions that focused on students making and constructing their understandings from active experience, rather than through transmission from teachers. Any conflicts to current understandings lead to further learning for connections, utilizing developmental levels and experiences to accommodate new information (Cohen, 1999; McMahon, 2000.; Moallem, 2003).

For the humanism statements, the framework was based on the work of humanistic psychologists such as Abraham Maslow, Carl Rogers, and Rudolf Steiner, who believe the whole person in addition to intellect is engaged in growth and development in pursuit of real learning. The whole person involves the emotions, the social being, the mind, and the skills needed for a career direction (Rogers, 1969). The statements were phrased so they included personal growth through real life problem-solving, learning through encouraging and nourishing environments with the idea that learning will flourish naturally because people have an inherent tendency to learn. Students are responsible for their behavior, so learning to make good choices and developing personal values helps promote the growth of the whole person (Cohen, 1999; McMahon, 2000.; Moallem, 2003).

The behaviorist statements evolved from the stimulus-response model of Skinner. Skinner believed that learning could be managed by affecting the variables of the situation, the behavior, and the results of the behavior (Bell, 1978). The behaviorism statements included the idea that extrinsic rewards lead to and result in all learning, teachers create and shape an environment to dictate student behavior and assesses learning of prescribed outcomes (Cohen, 1999; McMahon, 2000.; Moallem, 2003).

The critical theory statements are associated with the work of Kant, Hegel, Marx,
Weber, Lukacs, and Freud (Held, 1980). Critical theorists use critical thinking skills, inquiry, question-asking, and actions as teaching strategies. Students learn to handle conflict and to recognize multiple perspectives. Students are self-reflective with the goal of a positive contribution to society (Jensen, 1997). The statements included the idea that students should be involved in activities to criticize and shape society (Cohen, 1999; McMahon, 2000; Moallem, 2003).

Problem-based learning survey statements incorporate peer teaching (Barrows, 1996). The teacher is the facilitator and motivator of the students’ cognitive learning process and problem-solving skills with self-directed learning (Armstrong, 2012). The statements were designed to include the seven-step method for PBL: (a) clarifying terms; (b) defining the problem; (c) brainstorming; (d) structuring and hypothesis; (e) learning objectives; (f) searching for information; (g) synthesis (Bokonjic, 2009; Egidius, 1999).

As an application course, learning theories applied in an algebra 1 course should be the epitome of Lorain’s description of a middle school classroom, full of activity, stimulation, shared and reinforced learning (Lorain, 2015).

Data Collection and Analysis

The Spearman’s rho correlation is an appropriate data analysis tool to use with the quantitative variable of test scores from the 365 public schools in South Carolina that contain middle grade students. This correlation method has an advantage of a measured ranking system to easily read the results (Huck, 2012). The Spearman correlation will be used to determine the association between class scheduling and the performance on the End-of-Course testing in Algebra 1. The continuous variable for the correlation is the mean test scores. For this correlation, the ordinal variable is the ranking of class
scheduling times. This data will be collected through the analysis of the 2015 Algebra 1 EOC data pulled from the South Carolina Department of Education website’s data and accountability information. This data is made available on the state website for public viewing near the end of August, 2015. The class scheduling times will be determined from the annual school report cards found on the SC Department of Education website, school websites, and from the survey. The data for the learning theories study will be gathered from a Likert-scale analysis of the survey results. This survey will be sent out to the principals of the 365 public schools, along with the introduction letter, prior to the state required 2015 school start date of August 20. Reminder emails and survey links will be sent out mid-September. The learning theories data from the survey will be analyzed using the Learning Theories Scoring Guide created through the adaptation of material from Dr. Cohen (Appendix D). Microsoft Excel® Data Analysis Add-on correlation will be used to analyze the quantitative survey data of time and test scores. The statistical analysis from the Add-on will include a measure of central tendencies for the learning theories (e.g., frequency, mode, median, variance, range, and standard deviation). Inferential studies often do not require complex statistical analysis but is used when the full population is not available or does not participate (Ary, Jacobs, & Razavieh, 1990). Data gathered from surveys are analyzed using statistical tools such as tally or frequency counts; measures of central tendencies; measures of dispersion; and cross-tabulation correlation between categorical or nominal data (Fink, 1995).

**Summary**

Chapter 3 presents the purpose and goal of the study and the appropriateness of utilizing both a quantitative correlation study design and survey design. The correlation
study utilizes archived data of the 2015 EOC Algebra 1 Scores Report from the South Carolina Department of Education. Moreover, the study allows for the examination of relationships between scores and applied learning theories (Creswell, 2009). The chapter also describes the population and sampling structure, data collection, and analysis methods to be used.
References


Forrester, D., Jantzie, N. (1998) Learning Theories, [online], available:  


Appendix A

Learning Theory Survey

Thank you for participating in this survey. The answers you give are voluntary and the results will be confidential. If you have any questions or concerns, please contact me at jhaney2@gardner-webb.edu. You may end an incomplete survey at any time by closing your browser window.

In what school district do you teach? (List showing every public school district in South Carolina. The answer to this question branches to a district specific page.)

What is the name of your school? (District specific list.)

Middle School Grades:

Does your school include at least one of the grades 6-8? (An answer of no will sending the user to the submission page.)

Algebra Information:

Does your school offer an Algebra 1 course for high school credit? (An answer of no will sending the user to the submission page.)

Do you teach an Algebra 1 course? (An answer of no will sending the user to the submission page.)

How long is the instructional time for your Algebra courses? (90 minute block, 90 minute A/B block, 45-55 minute period, or 60-70 minute period)

List the percent (to the nearest whole percent) of your students scoring an A for the 2015 Spring Algebra 1 EOC test: (10% intervals)

List the percent (to the nearest whole percent) of your students scoring a B for the 2015 Spring Algebra 1 EOC test: (10% intervals)
List the percent (to the nearest whole percent) of your students scoring a C for the 2015 Spring Algebra 1 EOC test: (10% intervals)

List the percent (to the nearest whole percent) of your students scoring a D for the 2015 Spring Algebra 1 EOC test: (10% intervals)

List the percent (to the nearest whole percent) of your students scoring an F for the 2015 Spring Algebra 1 EOC test: (10% intervals)

Learning Theory Statements:
Appendix B

Invitation to Participate

Date

Dear Principal,

Your middle school mathematics department is invited to be a part of a research study on the relationship between class scheduling and results on the South Carolina Algebra 1 End-of-Course test. The study is a research project requirement for my doctorate at Gardner-Webb University. This research study will involve mathematics teachers who teach Algebra 1 to middle school level students at your school. The purpose of this study is to examine middle schools in South Carolina to find if there is a significant difference in student achievement on the South Carolina Algebra 1 End-of-Course test based on the scheduling type and to examine the learning theories teachers implement in their instructional practices.

The opinions of your algebra teachers will be very valuable to this study. Please read through the following survey questions to determine if you are willing to have your teachers participate in this study. If you are, please send the Google forms link containing the survey to your Algebra 1 teachers.

If you have any questions regarding the survey, please feel free to contact me by phone or email using the information listed below. Your cooperation is greatly appreciated. In addition, I will provide you the results of the study.

Sincerely,

Jennifer Haney
864-871-0553
Jhaney2@gardner-webb.edu
Appendix C

Author Permissions

Moallem, Mahnaz <moallemm@uncw.edu>
Thu 6/11/2015 10:56 AM
To:
Jennifer Haney;
You replied on 6/14/2015 1:38 PM.
Dear Jennifer,

Sorry for not responding to your message. I was out of the country and had limited time to respond to my e-mail messages. Of course, feel free to use this handout. I have to look through my materials to see if there are other materials that you could use. But, for several of my grants I have used Problem-Based Learning in assisting STEM teachers to apply it in their planning and implementation of their lessons.

Good luck for your research,
Mahnaz

Mahnaz Moallem
Program Chair AERA Cognition and Assessment SIG
Professor of Instructional Technology & Research,
Coordinator of Instructional Technology Program &
Grant Coordinator for Watson College of Education
=================================================================

Cohen, LeoNora <cohenl@oregonstate.edu>
Sat 6/6/2015 1:25 PM
Hi Jennifer,

The instrument was never validated, just designed to help students figure out more or less where they were in terms of philosophy. You can use the items.

Good luck.
Nora

McMahon, Joan D <jcmahon@towson.edu>
Fri 6/5/2015 4:07 PM
Good for you, Jennifer!
Permission granted and thanks for the inquiry. Good luck to you. It is a process, that dissertation.

Joan McMahon
10-733-0029
Appendix D

Learning Theories Scoring Guide

Cognitive Theory:
Cognitivists believe that education should focus on the child rather than the subject matter. The students' interests are important, as is integration of thinking, feeling, and doing. Learners should be active and learn to solve problems by experimenting and reflecting on their experience. Schools should help students develop personal and social values so that they can become thoughtful, productive citizens. Because society is always changing, new ideas are important to make the future better than the past.

\[
\begin{array}{ccccccc}
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3 & 16 & 18 & 25 & 27 & & \\
\end{array}
\]

Total = 

Critical Theory
Social reconstructionists (critical theorists) advocate that schools should take the lead to reconstruct society in order to create a better world. Schools have more than a responsibility to transmit knowledge, they have the mission to transform society as well. Reconstructionists use critical thinking skills, inquiry, question-asking, and the taking of action as teaching strategies. Students learn to handle controversy and to recognize multiple perspectives.

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5 & 7 & 10 & 17 & 30 & & \\
\end{array}
\]

Total = 

Problem-Based Learning
For information processing theorists, the focus is on how the mind of the individual works. The mind is considered to be analogous a computer. It uses symbols to encode, process, remember, and retrieve information. It explains how a given body of information is learned and suggests strategies to improve processing and memory.

\[
\begin{array}{ccccccc}
_ & _ & _ & _ & _ & _ & _ \\
4 & 9 & 15 & 21 & 28 & & \\
\end{array}
\]

Total = 

Behaviorism
Behaviorists believe that behavior is the result of external forces that cause humans to behave in predictable ways, rather than from free will. Observable behavior rather than internal thought processes is the focus; learning is manifested by a change in behavior. This is known as the stimulus-response theory of learning. The teacher reinforces what the student to do
again and again and ignores undesirable behaviors. The teacher's role is to develop behavioral goals and establish reinforcers to accomplish goals.

\[ \Box + \Box + \Box + \Box + \Box \text{ Total} = \Box \]

13 22 24 26 29

**Constructivism**
The learner actively constructs his or her own understandings of reality through acting upon and reflecting on experiences in the world. When a new object, event, or experience does not fit the learner's present knowing structures, a conflict is provoked that requires an active quest to restore a balance. Teachers facilitate environmental conditions and mediate experiences to support student learning.

\[ \Box + \Box + \Box + \Box + \Box \text{ Total} = \Box \]

1 6 12 19 23

**Humanism**
Humanist educators consider learning from the perspective of the human potential for growth, becoming the best one can be. The shift is to the study of affective as well as cognitive dimensions of learning. Beliefs include: human beings can control their own destiny; people are inherently good and will strive for a better world; people are free to act but must be responsible; behavior is the consequence of human choice; and people possess unlimited potential for growth and development. There is a natural tendency for people to learn, which will flourish if nourishing, encouraging environments are provided.

\[ \Box + \Box + \Box + \Box + \Box \text{ Total} = \Box \]

2 8 11 14 20