BLOCK SCHEDULING IN HIGH SCHOOL MATHEMATICS: EFFECT ON ALGEBRA II END-OF-COURSE GRADES AND ACT ASSESSMENT MATHEMATICS SCORES

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Block Scheduling in High School Mathematics: Effect on Algebra II End-of-Course

Grades and ACT Assessment Mathematics Scores

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Abstract

Gayle Hawkins Hughes. BLOCK SCHEDULING IN HIGH SCHOOL MATHEMATICS: EFFECT ON ALGEBRA II END-OF-COURSE GRADES AND ACT ASSESSMENT MATHEMATICS SCORES. (Under the direction of Dr. Carol Mowen) School of Education, December, 2008.

The purpose of this study was to determine if there was a statistical difference between end-of-course grades in Algebra II at three high schools in northeast Tennessee and mathematics content scores on the ACT Assessment at the same three schools, by comparing a one-semester accelerated (4x4) block schedule, a two-semester accelerated (4x4) block schedule, and a traditional year-long schedule. The purpose was also to determine if a relationship exists between Algebra II grades and ACT Assessment mathematics content scores for all students and for each school, and to determine if a statistically significant difference occurred in the number of students who continue their mathematics education by taking Trigonometry among the three different teaching schedules.

Seven null hypotheses were tested. Analyses showed a significant difference in grades among the three schedules, but not among the ACT Assessment mathematics scores. When comparing grades and ACT Assessment mathematics scores for the total population and for each schedule, a positive relationship occurred each time. When testing the last null hypothesis, it was determined that a significant difference occurred in the type of teaching schedule and enrollment in Trigonometry.

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To my dear friend Dr. Anne Runyan Littleford, thank you for encouragement to get started and accomplish what I have, and your guidance in this process. You are certainly my life-long friend.

Dedication

I want to dedicate this work to my parents, Mr. and Mrs. W. E. Hawkins, Jr. (Bill and Ann) and thank them for instilling in me, at an early age, the enjoyment of learning and the importance of being a life-long learner. You have supported me throughout my life, in all my educational endeavors and I certainly would not be where I am without you. I appreciate it more than you will ever know.

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CHAPTER ONE: THE PROBLEM

Introduction

There has been a national focus on mathematics and science education in the United States since the 1950s; the amount of instructional time needed for student learning is an ongoing educational issue in American high schools (Carter, 2002). The concern for strong mathematics and science education programs resulted from the launching of Sputnik, in 1957, by the Soviet Union (Rudy, 1965). This single event has come to symbolize the turning point in American education (Dow, 1991). Cavanagh (2007) states that, during the past four decades, business leaders and elected officials have suggested that, in order to meet foreign economic competition, America's students must improve their skills in mathematics, science, and other areas. As America faces the challenge of how to compete in the global economy today, it also faces the challenge of convincing the general public of the need for improvement in mathematics and science education (Cavanagh, 2007).

Suggestions from educators for reaching this goal are as widespread as the educators themselves. Many things come into play, such as states increasing the academic standards for students, mandates that *No Child Left Behind* impose on school districts, and expectations for all students to be proficient in all academic areas measured by standardized testing. As suggested by the Tennessee Department of Education, the current population of students must be taught to think with a greater depth of understanding and integrate what they learn into multiple situations. This is difficult to accomplish within a traditional school schedule that averages 55 minutes per class period.

Students have little time to absorb and reflect on what they have been taught (Opalinski, Ellers, & Goodman, 2004). The effectiveness of a traditional school schedule to meet the demands of the current education system has been discussed for several decades (Canady & Rettig, 1995), with mathematics educators having specifically debated the effectiveness of teaching high school mathematics courses on a block schedule rather than a traditional year-long schedule. The debate has been specific as to which of the mathematics courses are conducive to block scheduling and what age student can benefit most from this alternative approach (Marshak, 1997).

While most subjects are better taught on a block schedule, this is not necessarily true for high school mathematics. The teaching methods used in a traditional setting do not translate well to a block schedule (Kramer, 1996). Mathematics teachers have also expressed concern for retention due to the time lapse which can occur between classes in schools which utilize a block schedule (Salvaterra, Lare, Gnall, & Adams, 1999). Rettig and Canady (1998) state that on a block schedule, multiple concepts must be introduced each day. Many students need time to absorb material and practice skills, before moving to the next concept. Howard (1997) suggests using block scheduling in mathematics should be approached cautiously. Not all mathematics classes benefit from this change in schedule, and some schools have chosen to adopt a modified block schedule for teaching mathematics.

Students who have completed an Algebra II course in Tennessee should have been taught all of the objectives required by the Department of Education. With the mastery of these objectives, the student should be performing at an adequate level on the mathematics content area of the ACT Assessment, regardless of the schedule in which they have been enrolled while completing the Algebra II course. The Tennessee Department of Education (2008B) considers a score of 22 on the mathematics content test, by spring of a student's junior year of high school, adequate for success in college. Students who score 19-21 will not be required to take a specific mathematics course during their senior year, but a score below 19 is considered non-mastery and those students will be required to complete a Bridge mathematics course during their last year of high school.

The Problem

The problem of this study was to investigate and compare the effect of block scheduling and traditional scheduling on academic achievement in Algebra II, as measured by end-of-course grades and performance on the ACT Assessment in the area of mathematics. The schools and schedules compared are a one-semester accelerated (4x4) block schedule, a two-semester accelerated (4x4) block schedule, and a traditional year-long schedule at three northeast Tennessee high schools. This chapter describes the methodology used to determine if a significant difference exists between Algebra II end-of-course grades at the three high schools and ACT Assessment mathematics content scores at the same schools. Additionally, the relationship between Algebra II end-of-course grades and ACT Assessment mathematics content scores for each of the three schedules was determined; it was determined if a significant difference occurred in the type of teaching schedule and the enrollment in Trigonometry. The results of this study may provide insight as to student achievement related to school scheduling.

Purpose of the Study

The purpose of this study was to determine if there was a statistical difference between end-of-course grades in Algebra II at three high schools in northeast Tennessee and mathematics content scores on the ACT Assessment at the same three schools, by comparing a one-semester accelerated (4x4) block schedule at Ann Whitney High School, a two-semester accelerated (4x4) block schedule at Willis High School, and a traditional year-long schedule at Ernest High School. The purpose was also to determine if a relationship exists between Algebra II grades and ACT Assessment mathematics content scores for all students and for each school, and to determine if a statistically significant difference occurred in the number of students who continue their mathematics education by taking Trigonometry among the three different teaching schedules. For this study, the names of the high schools have been changed to ensure confidentiality.

For many students, mathematics is a complex subject to grasp, while it is essential for a solid education. Beginning with the freshman class of 2009-2010, students in Tennessee must complete Algebra II, in order to graduate from high school. This requirement applies to all students – those who are college-bound, and those pursuing an occupation in a technical field. This study determined whether or not students are mastering the mathematics content standards set forth by the Tennessee Department of Education (2008B), and if students are retaining the skills necessary to score at least 19 on the ACT Assessment in mathematics.

As of the school year 2008-2009, all juniors in Tennessee public high schools are required to take the ACT Assessment. A score of 22 is considered mastery in mathematics; students scoring less than 19 on the mathematics content area are required to take a Bridge mathematics course during their senior year of high school. The Bridge course is equivalent to a developmental mathematics course offered at a college or university. All high school students are required to take four years of math; Tennessee educators expect that the fourth year is Trigonometry, Calculus, or Statistics, and not a lower content course. This study considered three academic schedules in use by the selected high schools in northeast Tennessee, to determine which schedule is more conducive to retaining the objectives in Algebra II, which will, in turn, lead to a higher ACT Assessment mathematics content score.

Research Questions

In order to examine the results of Algebra II grades and ACT math content scores for three similar high schools – one on a one-semester accelerated (4x4) block schedule, another on a two-semester accelerated (4x4) block schedule, and the third on a traditional year-long schedule – seven null hypotheses were used to answer the four research questions investigated in this study:

1. Is there a significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule?

   H_o1_1: There is no significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated

(4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

2. Is there a significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule?

   H_o2_1: There is no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

3. Is there a relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics?

   H_o3_1: There is no relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

   H_o3_2: Among students who completed Algebra II on a one-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

H_o3_3: Among students who completed Algebra II on a two-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

H_o3_4: Among students who completed Algebra II on a traditional year-long schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

4. Is there a difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation of teaching schedule?

   H_o4_1: There is no difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation of teaching schedule.

Definitions

The following definitions are used to describe terms used in this study of school scheduling. Some of the terms are specific to Tennessee while others apply Nationally. In addition, several terms are subject to mathematics.

1. <u>Accelerated Block (4x4) Schedule</u> – An accelerated (4x4) block schedule is a way of organizing the school-day utilizing four class periods approximately 90 minutes in length. The students take four classes during the fall semester and four classes during the spring semester (Canady & Rettig, 1995).

2. Achievement – Achievement is the acquisition of concepts and skills, as measured by an assessment (Carter, 2002).
3. ACT (American College Testing) Assessment Exam – The ACT Assessment exam is a widely-used test for college entrance. Originally, ACT stood for American College Testing. In 1996, the organization's official name became ACT. The scale for scoring is 1-36 (ACT, 2008).
4. ACT Mathematics Test – This subtest of the ACT Assessment is scored on a scale of 1-36 and is comprised of sixty questions: (24) Pre-Algebra/Elementary Algebra, (18) Intermediate Algebra/Coordinate Geometry, and (18) Plane Geometry/Trigonometry (ACT, 2008).
5. Adequate Yearly Progress (AYP) – AYP is the measure of a school's or school system's ability to meet required federal benchmarks with specific performance standards from year to year (U. S. Department of Education, 2008).
6. Alternating Block (A/B) Schedule – Alternating block (A/B) scheduling is a way of organizing the school-day utilizing four class periods approximately 90 minutes in length. The students take eight classes during the school-year, alternating four every other day (Canady & Rettig, 1995).
7. Bridge Mathematics Course – The Bridge mathematics course is equivalent to a developmental college-level course. Beginning with the 2009-2010 school year, students in Tennessee receiving ACT Assessment mathematics scores below 19, during their junior year of high school, will be required to take the Bridge course as their fourth year of mathematics (Tennessee Department of Education, 2008B).

8. <u>Gateway Exam</u> – The Gateway Exam, 2002, in mathematics is the test required for graduation in Tennessee. A minimum score must be obtained and this will be in effect until end-of-course exams are developed to be implemented school year 2009-2010 (Tennessee Department of Education, 2008B).
9. <u>Instructional Time</u> – Instructional time is the length of time (in minutes) that a student spends in a single class per day, week, or term (Danielson, 2002).
10. <u>National Assessment of Educational Progress (NAEP)</u> – NAEP is known as the "Nation's Report Card." It is an assessment of what American students know and can do in various subject areas (The National Assessment of Educational Progress, 2008).
11. <u>National Defense Education Act (NDEA)</u> – NDEA was passed in 1958 and provides financial aid for mathematics, science, engineering, and foreign language education (Association of American Universities, 2008).
12. <u>*No Child Left Behind* (NCLB)</u> – NCLB is the reauthorization of the Elementary and Secondary Education Act of 1965. It was implemented during the 2002-2003 school year and mandates that all schools show 100% proficiency from their students in mathematics, reading, and language arts by 2014. Graduation and attendance standards must also be met (U. S. Department of Education, 2008).
13. <u>SASI™ (Student Administration System Information)</u> – SASI™ is the management system and database chosen by some schools to manage student information (Pearson Education, Inc., 2008).

14. <u>SAT (Scholastic Aptitude Test)</u> – SAT is a widely-used college admissions test. It measures knowledge of subjects learned in the classroom, including reading, writing, and math, and how well knowledge is applied outside the classroom (retrieved 10/12/08 from www.collegeboard.com, Learn more about the SAT).
15. <u>Socioeconomic Status</u> – Socioeconomic status is a measure of a family's relative economic and social standing (Marzano, 2003). For the purpose of this study, low-socioeconomic status will refer to those students who quality for free or reduced meals.
16. <u>Tennessee Curriculum Standards</u> – The Tennessee Curriculum Standards is the curriculum adopted by the State Board of Education, which will become more rigorous and increase in the depth of knowledge, beginning school-year 2009-2010 (Tennessee Department of Education, 2008A).
17. <u>Traditional Schedule</u> – Traditional scheduling refers to school schedules in which students take the same courses each day for the entire school-year. The time-frame for each class will vary slightly with the school and district (Canady & Rettig, 1995).

Organization of the Study

This dissertation is organized into five chapters. Chapter one presents background and a purpose for this study. Chapter two is a review of literature concerned with block and traditional scheduling, as well as literature and research about mathematics courses taught on both of these schedules. Chapter three contains the methodology used to gather and analyze data for this study. Chapter four contains the results of the data collection and statistical analysis of the data. Chapter five contains conclusions that can be made from the study and the implications for further research.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

Introduction

This literature review begins with a historical background concerning both public schools and school scheduling. Descriptions of a traditional schedule, an accelerated (4x4) block schedule, and an alternating (A/B) block schedule are provided along with the advantages and disadvantages of each schedule. An example of each schedule is illustrated, even though all schools do not adhere to the same time-frame. Research studies and data concerning student achievement in mathematics, with regard to the various types of academic schedules, is provided.

Historical Background

The American common school, or public school as we know it today, emerged in response to the conditions of American life (Cremin, 1951). Even though public education had been in effect for several decades, the American high school did not have its chief development until the 20th Century. As late as 1860, there were only 321 high schools in the United States. The actual period of expansion did not begin until the 1890s (Gorman, 1971). During the expansion, the Committee of Ten on Secondary Studies was commissioned by the National Education Association. This committee evolved out of concern from colleges that there was no continuity among requirements for American high schools; they were to recommend standards for the various subjects in the secondary school curriculum. Nine conferences were included by the Committee of Ten, based on the academic disciplines of: 1) Latin; 2) Greek; 3) English; 4) Modern Languages; 5) Mathematics; 6) Physics, Astronomy, and Chemistry; 7) Natural History; 8) History, Civil Government, and Political Economy; and 9) Geography. Their work should be viewed as an early part of the larger progressive movement that helped to gradually transform America's pubic schools (Bohan, 2003). The report of 1893 formed what is known as the modern system for secondary education (Belting & Coffman, 1923). The result of this report led to strides in uniform standards of curricula, organization, and programs. It was stated, that a short course taught because of a teacher's interest was not acceptable and specific courses that were needed in each of the four years of high school were outlined. The basic courses required for all students were English, mathematics, history, and science. There was also an emphasis on languages, specifically Latin, Greek, and either German or French. In addition, the Committee of Ten recommended a more integrated approach and stated that students were entitled to the best methods of teaching various subjects and investigation and exploration were encouraged (Bohan, 2003). A major result of the report was a structured four-year curriculum that required students to be in class an allotted amount of time per week. The report was supported by some educators and strongly criticized by others. The lack of industrial and commercial subjects drew criticism from every one of the committee members (Gorman, 1971).

During this Progressive Era, the number of students in American high schools rose dramatically. The number of high school graduates increased from 16.8% of the population in the 1920s to 50.8% of the population in the 1940s (Bohan, 2003). The demographics of public education were also changing. Foreign students were increasing in number and equal opportunities for both boys and girls were expected. Even though racial segregation would be prevalent in the United States until the 1960s, there was increased access to education, as evidenced by the growth in the number of schools and the number of students attending schools. The comprehensive high school model still in place today, is a result of the progressive education movement (Bohan, 2003).

Even under the Committee of Ten program, all subjects did not meet equal amounts of time. Some, such as languages, met daily, while other subjects might only meet two to four times a week. “In 1906, the Carnegie Foundation for the Advancement of Teaching established what came to be known as the Carnegie unit” (Marshak, 1997, p. XI), but it would not be finalized and put into effect until 1909. Gorman (1971) states that this unit is a by-product of a pension fund that was set up for college professors. Andrew Carnegie gave $10 million to the Carnegie Foundation for the Advancement of Teaching that was used to establish a retirement fund for college professors. At the time, there were no clear criteria for a professor, so the foundation set to establish the definition of a college professor, a college, and in the process, also defined minimum credits for high school graduation. For the first time in American history, there was a clear division between high school and college. The Carnegie unit, as we know it today, is equivalent to 45-minute classes being taught for 180 days, totaling 120 hours of instruction. A four-year high school program was defined as the completion of 14 Carnegie units (Carnegie Foundation for the Advancement of Teaching, 2008).

Six-, seven-, and/or eight-period days evolved from this movement and students simply moved from classroom to classroom earning their credits toward high school graduation. Lecture was the teaching method of choice and rote learning was the goal of both the teacher and the student. “Students learned punctuality, obedience to authorities, and tolerance of repetition, boredom, and discomfort” (Lawrence & McPherson, 2000).

By 1918, “the National Educational Association’s *Report on the Reorganization of Secondary Education* solidified the normative status of the comprehensive high school with separate college preparation and general education tracks” (Marshak, 1997, p. XI). The report wanted a common school where the students on both tracks would have similar courses, but the college preparatory track would be more rigorous and challenging. Educators and policymakers believed that learning took place through the transmission of information from teacher to student. The teachers talked and the students listened. It was thought that the best education occurred when the teacher lectured alone, without any interaction among the 30 or so students in the classroom. The role of the teacher and student were standardized, regardless of grade level or discipline. If the student successfully produced the correct answer, then he/she was rewarded with a passing grade (Gainey, 1993).

With the end of World War II, America focused again on education. The war “had a profound effect on people’s ideas about the need for mathematics” (Willoughby, 2000, p. 3). Stimulated by the success of the Manhattan Project and other war-related research activities, it was realized that formal knowledge could make a significant contribution to society (Dow, 1991). Due to the educational system at the time, Willoughby explains that many young men and women in the United States were unable to perform or understand the mathematics needed to navigate airplanes or ships, operate weapons systems, or maintain supplies. The military was forced to provide crash courses in mathematics for recruits. Educators, scientists, and mathematicians pushed for stronger mathematics programs in public education, but, at best, students were receiving courses in general mathematics. Very bright students would many times only complete first-year algebra. By the mid 1950s curriculum improvements had been underway for nearly a decade, but people were still anxious about National security and the adequacy of American schools (Dow, 1991). On October 4, 1957, the Soviet Union successfully launched Sputnik and America was in shock. This feat led to a questioning of the efficacy of American secondary education and a demand for evaluation (Connell, 1980). It was believed that National security was at risk and, for the first time in history, the federal government poured money into education. The National Defense Education Act of 1958 (NDEA) provided aid to all levels of education. It primarily focused on enhancing research facilities and providing financial aid to those persons pursuing degrees in science, mathematics, engineering, and foreign languages (Association of American Universities, 2008). The Association of American Universities states, “By supporting students and the nation’s research and education infrastructure, NDEA helped to spur innovation that led to greater national and economic security” (p. 1).

Throughout the 1960s and 1970s, the federal government continued to support education and encourage rigor in the courses offered. Social awareness emerged as part of public education and President Johnson’s vision of the Great Society spurred programs such as Head Start and vocational schools (Connell, 1980). During this time, even with the addition of new programs, rigorous curricula, and new teaching practices, the structure of the school and school day remained the same as it had been for many years.

School Schedules

School schedules have been a debate in the United States for several decades. Until the 1980s, the high school structure had remained unchanged for most of the 20th Century and students took core courses in science, math, history, English, and little else. Each subject was taught separately by a different teacher (Marshak, 1997, p. XI). “During the early 1980s and again during the early 1990s, school personnel were bombarded with reports on the inefficient and ineffective use of school time” (Canady & Rettig, 1995, p. 2). Since its conception, the school year and length of the school day remained unchanged and student learning was at the mercy of time. As a result of the report published by the National Commission on Excellence in Education, A Nation at Risk (United States, 1983), Americans began to question the effectiveness of the current American education system. The National Commission on Excellence in Education asked: How do we use time? How do we allocate time? How do we account for time? The response to these questions from many legislators was to increase both the school day and the school year (Canady & Rettig, 1995). Educators did not agree. Many administrators and teachers said merely an extension of the school day would only require more busy work for students and teachers, and that educators should become more efficient with the time already allocated. Gilman and Knoll (1983) (as cited in Canady & Rettig, 1995) calculated that “a fair estimate of the average time devoted to instruction during a school day is probably less than 30 percent” (p. 3). Justiz (1984) reported that 16% or approximately one hour of instructional time each school day was lost on the average “in the process of organizing the class and by distractions resulting from student conduct, interruptions, and administrative processes." As cited in Canady & Rettig, (1995), Karwiet (1985) "reported research findings that suggest students engage in productive academic activities only 38 percent of the school day" (p.3).

More than any other organization, schools are time-conscious and time-bound (Schlechty & Clinton, 1991). The National Education Commission on Time and Learning (United States, 1994) recommended these suggestions for school scheduling practices: Schools should be reinvented around learning, not time. State and local boards should work with schools to redesign education so that time becomes a factor supporting learning, not a boundary marking its limits. Sommerfield (1994) (as cited in Canady & Rettig, 1995) said schools should provide additional academic time by reclaiming the school day for academic instruction and teachers should be provided with the professional time and opportunities they need to do their jobs well This was an effort to escape from the box and create a structure for schools based on human development, learning and teaching, the nature and structure of knowledge, the cultural and social realities of the present and expectations for the future (Marshak, 1997).

During the later part of the 20th Century, it was realized and expected that students required a different type of education. The current population of students was very different than their parents and grandparents who had been educated in a very traditional setting. Society expected students to be educated in traditional areas, as well as, develop skills in decision making, technology, moral character and leadership, and in higher-level science and mathematics courses. During the 1980s, graduation requirements began to rise in most states. As a result, the students had very little time in their schedule for electives, and the vocational programs in many schools suffered. Some schools shortened periods to provide time in the school day for additional classes to be taken to increase the number of credits for graduation. Some of these schedules only allowed for 40-minute classes and, by the time the administrative tasks were conducted, the teacher was limited to 25-30 minutes to teach the lesson. In addition, there was a concern with the time it took to change classes. Even with five minutes between classes, many felt time that could be used for instruction was being wasted. These additions to the curriculum required educators to look at current school schedules within the public school system (Canady & Rettig, 1995).

Variations in School Schedules

Block scheduling, which first came into being but was strongly rejected, during the 1960s, was becoming a popular choice for an alternative school schedule during the late 1980s and 1990s. For many schools it was the answer to their dilemma, as its greatest strength is flexibility and adaptability (Hottenstein, 1998). Today, more than 50% of all high schools use some type of block scheduling, not only to gain educational instruction time, but to address accountability demands, reduce discipline problems, enhance learning through longer classes, and to improve test scores (Gruber & Onwuegbuzie, 2001).

Traditional Scheduling

Traditional scheduling typically refers to a school day in which the time is divided into six, seven, or eight periods. The classes may last from 40 to 60 minutes, and the students take the same classes for the entire school year. The time allotted for class change is usually five to ten minutes. Teachers typically have one period free for planning and teach the rest of the day. In Tennessee, the class size limit for most high school subjects is thirty-five students, so a teacher's student load could very well exceed 150 pupils per day. Table 1 shows an example of a traditional schedule for a typical school day.

Table 1

A Traditional Seven-Period Schedule for a United States High School (year-long)

Time	Period	Monday	Tuesday	Wednesday	Thursday	Friday
7: 40-8:35	1st	Science	Science	Science	Science	Science
8:40-9:35	2nd	Spanish	Spanish	Spanish	Spanish	Spanish
9:40-10:35	3rd	History	History	History	History	History
10:40-11:35	4th	English	English	English	English	English
11:40-12:00	4th	Lunch	Lunch	Lunch	Lunch	Lunch
12:05-1:00	5th	Math	Math	Math	Math	Math
1:05-2:00	6th	Chorus	Chorus	Chorus	Chorus	Chorus
2:05-3:00	7th	Art	Art	Art	Art	Art

It has been reported that a traditional schedule does not support the changes needed to be made in high schools across the country; in fact, it was often lamented that "the schedule was the problem" (Canady & Rettig, 1995, p. 4). Single period schedules tend to fragment the school day for both the student and the teacher. The periods are so short they become impersonal and students are expected to attend classes and perform to the best of their ability for six, seven, or even eight teacher-supervisors. Throughout the school day, students must adapt to the expectations, teaching styles, and personality of multiple teachers. Physically, students must adjust to changes in lighting, heating and air, acoustics, and desks in each classroom – a schedule that is hectic, impersonal, and unproductive for the changing American high school student.

Teachers express concern with regard to the traditional schedule, indicating a lack of important relationships with their students, due to the time in the classroom and the number of students taught each day. Instruction time is limited to mostly lecture, even though most educators are aware this is not the most effective method for teaching objectives. They feel time is not available for investigation, exploration, or cooperative learning. Discipline problems have also been attributed to the traditional school schedule. During multiple times in the school day, hundreds, maybe thousands of students pour into the halls to change classes. The more often this occurs the greater the chance of problems. If a problem arises and the student is not sent to the office, it may escalate and continue into the classroom. With so little time, many teachers simply expel the student from class and continue teaching. Then, the person in trouble misses out on classroom instruction.

Each student is different and some need more time to learn than others. A traditional schedule is ineffective for students who realize in January that they cannot pass the class. Most students will then spend the entire spring semester doing nothing.

Many students will then become discipline or absentee problems. They must wait until the summer or next school year to start over and, even though these students should ideally try to learn as much as possible to help them when repeating the class, most high school students will simply not see the importance.

Block Scheduling

According to Canady and Rettig (2000), “A school schedule can have an enormous impact on a school’s instructional climate” (p. 375). As educators struggle with the problem of how to effectively educate the students of the twenty-first century, alternative schedules were developed. The most prominent of these is the block schedule that allows a larger block of time for classes to be taught and students take fewer classes per day. There are two basic patterns for block scheduling: an accelerated (4x4) block where students complete four courses in the fall semester and four additional courses in the spring semester, and the alternating (A/B) block where students alternate their six to eight courses on a daily basis. Most high schools utilize an accelerated (4x4) block system. Table 2 illustrates an accelerated (4x4) block schedule and Table 3 illustrates an alternating (A/B) block schedule.

Table 2

A Typical Accelerated (4x4) Block Schedule (fall semester)

Time	Block	Monday	Tuesday	Wednesday	Thursday	Friday
7: 40-9:10	1st	Math	Math	Math	Math	Math
9:18-10:48	2nd	English	English	English	English	English
10:56-12:26	3rd	Science	Science	Science	Science	Science
12:34-1:02	3rd	Lunch	Lunch	Lunch	Lunch	Lunch
1:10-2:40	4th	Band	Band	Band	Band	Band

A Typical Accelerated (4x4) Block Schedule (spring semester)

Time	Block	Monday	Tuesday	Wednesday	Thursday	Friday
7: 40-9:10	1st	Spanish	Spanish	Spanish	Spanish	Spanish
9:18-10:48	2nd	Geography	Geography	Geography	Geography	Geography
10:56-12:26	3rd	Technology	Technology	Technology	Technology	Technology
12:34-1:02	3rd	Lunch	Lunch	Lunch	Lunch	Lunch
1:10-2:40	4th	Band	Band	Band	Band	Band

Table 3

A Typical Alternating Block (A/B) Schedule

Time	Block	Monday	Tuesday	Wednesday	Thursday	Friday
7: 40-9:10	1st	Science	Art	Science	Art	Science
9:18-10:48	2nd	Chorus	Math	Chorus	Math	Chorus
10:56-12:26	3rd	French	History	French	History	French
12:34-1:02	3rd	Lunch	Lunch	Lunch	Lunch	Lunch
1:10-2:40	4th	Accounting	English	Accounting	English	Accounting

Advantages of Block Scheduling

Many educators and students alike are fond of block scheduling; the advantages are numerous. The main advantage of both the accelerated (4x4) block schedule and the alternating (A/B) block schedule is that students take only four classes at a time, which allows them more time to concentrate on fewer subjects and studying for tests and quizzes is not so cumbersome. In addition, with only four classes, students are not "overwhelmed by numerous sets of class rules, multiple homework assignments, and disjointed curricula" (Gruber & Onwuegbuzie, 2001). If a student must be absent, his/her work is easier to gather and monitor, which is a great advantage for both the teacher and the student.

With fewer classes, there are also fewer class changes. Many discipline problems occur in the halls during class change and with only three changes, fewer problems occur. According to Matarazzo (1998) (as cited in Gruber & Onwuegbuzie, 2001), "Student satisfaction as measured by attendance, dropout rate, discipline referrals, and student suspensions, rose after implementation of a block schedule" (p. 33). In addition, Eineder and Bishop (1997) and Mistretta and Polansky (l997) (as cited in Gruber & Onwuegbuzie, 2001) also found a decrease in discipline referrals and dropout rates after block scheduling was implemented. "Many studies have found that block scheduling and other scheduling options benefit some at-risk students, who achieve at higher levels when allowed to take fewer courses on a more intensive basis" (Danielson, 2002, p. 29). Administrators have also found more flexibility in scheduling with students taking eight classes during a school year rather than six or seven (Kramer, 1996).

Matarazzo (1998) (as cited in Gruber & Onwuegbuzie, 2001) states students' attitudes towards school and their approach to learning had positively changed due to the block schedule. A students' attitude towards learning is a key factor in the teaching-learning process. Without a positive attitude from the students, the educational outcome will not be as great. According to Danielson (2002), "block scheduling is advantageous because it provides longer instructional time and more opportunities for engaged learning" (p. 48).

The block schedule has a positive effect on teacher attitudes as well. Many teachers feel they have more time to devote to lesson preparation and, with a 90 minute block, teachers are likely to employ a variety of approaches in contrast to classes limited to 40 to 60 minutes. As with any schedule, however, teachers must use their instructional time wisely and provide a variety of teaching strategies during a block class. “Teachers accustomed to relying on lecture find that they need to vary their approach under block scheduling, enabling students to engage in deeper and more sustained exploration of content” (Danielson, 2002). Kramer (1996) also states that lecturing alone does not work well in a longer block class period and that mathematics teacher are less likely than others to change their methods of teaching to adapt to the lengthy class. Teaching on a block schedule does not come naturally for all teachers. Training must occur, and it is best to provide this for teachers before they actually teach on the alternative schedule. The training should extend throughout the school year and parents should also be informed as to how the schedule is different for their student (Mowen & Mowen, 2004).

In many instances educators feel they have more opportunity to collaborate with colleagues. Teachers also feel they have additional time with individual students and can build positive relationships within the classroom. Findings presented by the Georgia Department of Education, in 1998, revealed that the greatest advantage found in block scheduling pertains to an improvement in the school climate for both teachers and students (Gruber & Onwuegbuzie, 2001). In addition, teachers who serve in more than one school find this schedule attractive because they have fewer changes during the day and, in some cases, a longer travel time.

There are several advantages to an accelerated (4x4) block schedule that an alternating (A/B) block schedule does not have. Teachers on both block schedules teach three classes a day and have an hour and a half for planning, but on an accelerated (4x4) block schedule they will be preparing for fewer courses to teach and their student load should be 90 students or less. This allows the teacher to get to know those students and their immediate needs. The record-keeping and grading of papers for a lesser number of students allows the teacher to give feedback quickly. From the student's point of view, the use of an accelerated (4x4) block schedule allows them to take more classes throughout the school year (Mayo, 2003) and truly immerse themselves in those courses. As state departments raise graduation requirements, the need arises for students to complete more classes to fulfill their high school requisite. Eight classes can be completed per school-year using the accelerated (4x4) block schedule, while allowing the student to concentrate on four classes per semester. In many cases, it allows the students to take fine arts classes and vocational-technical classes they would otherwise be unable to take. Students have a greater opportunity for acceleration with accelerated (4x4) block schedule because they can take two complete mathematics courses, in one school year. Another advantage to accelerated (4x4) block scheduling is there is time to repeat a class, if necessary. If a student is not successful in a class taken during the fall semester, he/she is able to repeat it immediately in the spring. With an accelerated (4x4) block schedule the students have an opportunity to complete more classes prior to taking the ACT Assessment or SAT Assessment and, for bright students, they may choose dual enrollment with a local college during their senior year of high school. Last, a great advantage is financial, as fewer textbooks are needed because a student only uses a book for one semester and then they have a new schedule with all new classes the following semester (Canady & Rettig, 1995).

Disadvantages of Block Scheduling

Time can be one of the disadvantages of block scheduling. Since classes are approximately 90 minutes long, the material presented each class period is equivalent to what would be presented in two days on a traditional schedule. There is a difference in the actual time spent in the classroom, when comparing a block schedule to a traditional schedule. A block schedule has 90 minutes each day for 90 days, totaling 8,100 minutes of instruction for the course. A traditional schedule averages 50 minutes each day for 180 days, totaling 9,000 minutes of instruction. A difference of approximately 900 minutes occurs between the schedules.

Teachers, on a block schedule, have sometimes found it necessary to re-examine their curricula, reduce review, and eliminate less important objectives. As the number of objectives is decreased, the depth of coverage must increase, leading to a better understanding from the students (Kramer, 1996). Curriculum integrity with the accelerated (4x4) block schedule is a major issue. Canady and Rettig (1995) argue that even if teachers have to reduce or change their curriculum, the quality of the curriculum is better than a traditional schedule. The discussion will continue to occur concerning the usefulness of 8,100 minutes as opposed to 9,000 minutes, but if systems lengthen the school day to make the number of minutes per course the same as in a traditional schedule, this would not be considered a disadvantage.

The schedule for students must be balanced for both fall and spring semesters with the accelerated (4x4) block schedule or a student may have non-rigorous classes in one semester and find him/herself so academically challenged that they do not perform to their best level of ability in the next semester. Another disadvantage to be addressed is keeping students enrolled in school through their senior year, as those students taking only the minimum number of courses can finish the required curriculum prior to their senior year of high school. Some districts have added credits required for graduation and others have allowed Advanced Placement (AP) classes to be taken only during a student's senior year of high school.

While most discipline issues decrease in schools utilizing a block schedule, in cases where a student is suspended for 10 days or more, the student probably cannot catch up and is forced to repeat the class. If a student is ill or must miss school for a day, there is essentially two days of material to make-up rather than one, which can be very difficult for many students. Another problem with block scheduling is revealed when students move from school to school, which is prevalent in today's society (Gruber & Onwuegbuzie, 2001). In some cases, students who have moved in the middle of the school year have lost credits because of schedule differences. Transferring between schedules during the school year is discouraged, but most schools simply make decisions on a one-to-one basis if they have less than a 30% transient rate (Canady & Rettig, 1995).

For the student who has difficulty paying attention during a 90-minute class, block scheduling is a problem. It is nearly impossible for a teacher to lecture for the entire 90 minutes, but the student must still stay engaged in the teaching-learning process the entire class period. The pace is much quicker and some students have trouble processing a large amount of information within a block of time (Mayo, 2003).

Mathematics Instruction

Teaching mathematics utilizing a block schedule is a very difficult thing for teachers to master. The literature indicates that lecturing is less effective during a block scheduled class than traditional schedule. Pedagogical methods that teachers have learned from years of experience in a traditional setting, do not translate well to a block schedule (Kramer, 1996). Mathematics teachers are less likely than teachers of other subjects to change their teaching methods, but must do so to be effective educators, utilizing a block schedule (Kramer, 1996). In addition, mathematics teachers expressed concern for retention due to the possible time lapse, which could occur between mathematics courses (Salvaterra, Lare, Gnall, & Adams, 1999).

Rettig and Canady (1998) state that successfully completing Algebra I has been identified as a key factor for further academic accomplishment in mathematics. This is the first high school mathematics course for most students. By the nature of the subject, mathematics builds on skills learned each day. If a student does not have a good grasp of a concept learned one day, it is difficult to master the next concept. On an accelerated (4x4) block schedule, multiple concepts must be introduced each day. Some mathematically-talented students are successful at this pace, but many need time to absorb material and time to practice on concepts before moving ahead to additional objectives. The block schedule does not allow time for this. What will take 36 weeks to complete on a traditional schedule, must be taught in 18 weeks on an accelerated (4x4) block schedule. When taught on a traditional schedule, students who are unsuccessful at the beginning of the course never catch up and must repeat the entire year. There is not a schedule that will best for all students. To ensure future success in mathematics, the students cannot complete Algebra I at a speed too fast for retention.

The teaching of mathematics on a block schedule can be done, but must be monitored carefully. Mathematics comprehension and grades must be tracked over time (Mayo, 2003). Schools should be somewhat flexible in their scheduling because if students are not mastering required mathematics, modifications to the schedule should be made. Many schools have in recent years changed to a modified block schedule for mathematics, to allow Algebra I to be taught all year, but few have made the same accommodations for required courses taught beyond this level.

Academic Achievement

A wide variety of literature is available on the academic effects of block scheduling with mixed results. Many factors other than an academic schedule must be considered when assessing student achievement, including curriculum, instructional strategies, family support, and socioeconomic conditions (Gruber & Onwuegbuzie, 2001). DiRocco (1999) studied block scheduling at a middle school in Pennsylvania. His investigation “revealed that final course averages, grade point averages, and the means of four out of six achievement tests were higher for those students who received instruction via the block schedule method” (p. 34). In contrast, a study presented by the Georgia Department of Education “found no clear-cut evidence to support the theory that block scheduling has a positive effect on student achievement” (Gruber & Onwuegbuzie, 2001, p. 38).

Gruber and Onwuegbuzie’s (2001) study was to determine the effects of block scheduling on academic achievement. Their participants were 115 high school students who received instruction on an accelerated (4x4) block schedule and 146 students who received instruction on a traditional schedule. “A series of independent t-test, utilizing the Bonferroni adjustment, was conducted to compare grade point averages and scores on the Georgia High School Graduation Test (GHSGT) between the two groups” (p. 32). Results of the study found no statistically significant difference in grade point average or on the writing portion of the state test between the two groups. The results differed for subject sub-tests. Students on a traditional schedule had statistically significant higher scores on sub-tests in language arts, mathematics, social studies, and science. The results indicate that teaching students on a block schedule does not have a positive effect on academic outcome among high school students. It was noted that the findings may be skewed because the research was conducted during the first three years of block schedule implementation, which may not have given teachers an opportunity to adjust their teaching styles. A second factor that may have skewed data was the attendance level at one of the schools involved in the study.

A study conducted by Mayo (2003) revealed that students on traditional schedules achieved higher mean end-of-course state exam scores in Algebra I, Biology, English I, and United States History than students on a block schedule. It should be noted that participating students on traditional schedules had lower course grades in equivalent classes as their counterparts on the block schedule. A question arising from this research is: Are the course grades higher because of alignment with the curriculum or do students on the block schedule make better grades in particular classes? A final finding from this research implicates that more students fail Algebra I on block schedule than on a traditional schedule. A similar study completed by Lawrence and McPherson (2000) indicates that students taking Algebra I on the block schedule have a higher failure rate than those completing the course on a traditional schedule.

An ex post facto (“after the fact”) study conducted in a northern Colorado city of approximately 125,000 used a longitudinal research design that included 355 students with similar demographics from four junior high schools (grades 7-9) and three high schools (grades 10-12), where 96% of the students participated in the same schedule format for both junior high school and high school. The sample for the study consisted of students who met the following criteria: (a) Attended one of the four junior high schools during the 2000-2001 school-year and completed a reading and/or mathematics Levels test in the spring of 2001; (b) Attended one of the three high schools during the 2002-2003 school-year and completed the reading and/or mathematics ACT Assessment in the spring of 2003. The schedules were a traditional schedule, an accelerated (4x4) block schedule, and an alternating (A/B) block schedule. The demographics for the schools were similar and even though the population for one junior high school had a greater free and reduced lunch population, by the time they reached high school, there was little difference in the schools. The student data was collected over a two-year period and analyzed using three methods. First, the mean differences between the 9th grade Levels test and the 11th grade ACT Assessment test in mathematics and reading was calculated for all three schedules. Second, a single-factor analysis of variance (ANOVA) was generated to determine the effect of the three schedules on the Levels test and the ACT Assessment content scores. Finally, a 3x2x2 factorial analysis of variance was conducted to analyze the test score data for main and interaction effects by ethnicity and gender. Gain scores were calculated and converted to z-scores to allow for comparisons between the two sets of testing data (Lewis, Dugan, Winokur, & Cobb, 2005).

The standardized mean differences in both reading and mathematics were negative for the traditional schedule and alternating (A/B) block schedule, indicating that students experienced a decline in achievement over time, while students on the accelerated (4x4) block schedule showed the greatest increase in achievement over time in both reading and mathematics. When the effect sizes were calculated, it was determined that the alternating (A/B) block schedule students had the smallest gain score, followed by the students on the traditional schedule. When a single-factor ANOVA was conducted on the standardized z-scores for both the Levels test and the ACT, there was no statistical difference found in mathematics achievement, however, there was a statistically significant difference found in reading. The results from the factorial ANOVA indicated no statistically significant main or interaction effects for the gain scores in mathematics. However, in reading, the students on the accelerated (4x4) block schedule outperformed the other two groups. The results of this study support the presumed advantages of block scheduling and particularly an accelerated (4x4) block schedule. Those conducting the study advise more research in specific content areas may be necessary to support the findings (Lewis, Dugan, Winokur, & Cobb, 2005).

Pliska, Harmston, and Hackmann (2001) report the findings from the first phase of a longitudinal study of 568 public high school students in Illinois and Iowa examining the relationship among ACT Assessment scores and three types of school scheduling. A traditional schedule and both alternating (A/B) and accelerated (4x4) block schedules were investigated; only those schools with a pure model were chosen for the study. The participants for the study were high school seniors who completed the ACT Assessment in 1999. Because the intent of the researcher was to investigate the effectiveness of school schedules, the mean of the composite ACT Assessment score was used at each school level. The researcher selected several potential control variables that were considered related to achievement. Among these were school size and lifestyle factors, such as parental education level, geographic area, ethnic mix, and socioeconomic status.

Results of the study indicate that, when examining the mean ACT Assessment composite score for the three schedules, the difference in scores was negligible. The mean composite score for traditional schedule schools was 21.28, the alternating (A/B) block schools' composite score was 21.13, and the composite score was 21.36 for the accelerated (4x4) block schools. Descriptive data on the ACT Assessment composite scores within each schedule, and the individual control variables were then analyzed. Within states, the differences in schedule types were negligible, whereas differences did occur within the control variables for both states. Elite schools outscored both urban mid-scale and urban core schools, regardless of schedule.

This study had several limitations, which include faculty support for varying types of school scheduling, the mean ACT Assessment score was a composite for the entire school and not individual students, the schools were in the Midwest, and the researcher did not take into account the percentage of low socioeconomic students at each school. The results indicate, that simply changing a school schedule will not result in short-term dramatic improvement in ACT Assessment scores (Pliska, Harmston, & Hackmann, 2001).

Implications for Future Research

The debate between a block schedule and a traditional schedule will likely continue for years to come. Further research is needed to conclude which schedule actually makes a positive impact on student achievement. Subject-specific studies would be valuable, since it is known among educators that all content areas cannot be taught by the same methods. As standards rise and rigor is expected in all academic areas, it would be useful to determine if one schedule can make a positive impact on student learning, as measured by end-of-course grades and standardized assessments.

Summary

The structure of the American high school remained relatively unchanged for nearly 100 years. Each subject was taught by a separate teacher in a class period that lasted 45-55 minutes with little or no interaction between disciplines (Marshak, 1997). Mistretta & Polansky (1997) (as cited in Carter, 2002) suggest that for many years high schools in the United States held time constant and let learning vary.

By the late 1980s, block scheduling emerged as a structuring practice that allowed educators to address growing problems with the traditional high school schedule, where teachers were under enormous pressure to educate the large numbers of students who came through their classrooms each day (Jenkins, Queen, & Algozzine, 2002). Graduation requirements were rising and, with the need for additional classes, the traditional high school schedule no longer met the needs of American students (Canady & Rettig, 1995). According to Fuson, De La Cruz, Smith, Lo Cicero, Hudson, Ron, and Steeby (2000), as the 21st Century unfolds, educators carry some of the unsolved problems with them.

There are advantages and disadvantages to a block schedule, but the advantages outweigh the disadvantages. Stokes and Wilson's (2000) longitudinal study of four high schools revealed positive outcomes as a result of block scheduling, including increased standardized test scores and daily attendance, while dropout rates, failure rates, and discipline problems decreased. Additionally, a block schedule can help at-risk increase success, by allowing them to concentrate on fewer courses at a time. With a block schedule, all students have an opportunity to study courses more closely and interact with other students during the longer academic period (Childers & Ireland, 2005).

While most subjects are better taught on a block schedule, this is not necessarily true for high school mathematics. Rettig and Canady (1998) state that successfully completing Algebra I is a key factor for further academic accomplishments in mathematics. On a block schedule, unless the class meets daily for the entire school year, multiple concepts must be introduced each day. Many students need time to absorb material and practice skills, before moving to the next concept. Howard (1997) suggests using block scheduling in mathematics should be approached cautiously. Not all mathematics classes benefit from this change in schedule, and some schools have chosen to adopt a modified block schedule for teaching mathematics.

CHAPTER THREE: METHODOLOGY

Research Design

This investigation was an ex post facto study examining student achievement in Algebra II as determined by end-of-course grades and scores on the ACT in the mathematics content area. The data were collected from the 2008 graduating class at each of three chosen high schools in northeast Tennessee. The students completed Algebra II in school years 2005-2006, 2006-2007, or 2007-2008; the ACT Assessment mathematics content area score used for this study was the score earned immediately after course completion. Additional data were used to determine internal validity concerning comparisons among the three high schools. The names used in the study, Ann Whitney High School, Willis High School, and Ernest High School are not the actual names of the schools. The variables used for validity purposes were socioeconomic status and gender.

Selection of Participants

The participants for this study include students at Ann Whitney High School in Community 1, students at Willis High School in Community 2, and students at Ernest High School in Community 3, Tennessee. The population included for this analysis was the 2008 graduating class at each high school. The participants were those students in the 2008 graduating classes who took the ACT Assessment within a semester of course completion. If a student chose not to continue with a mathematics course of study, the first ACT Assessment test score following completion of the Algebra II course was used. The 2008 graduating class at Ann Whitney High School numbered 447, Willis High

School numbered 338, and the graduating class from Ernest High School included 186 students. Between 33% and 54% of each graduating class met the criteria for the study.

These three schools were chosen for this study for their similarities in population, diversity, economic base of the community in which they are housed, and that they are all the single public high school in their respective communities. In addition, the schools are located approximately 30 miles apart and, except for the difference in academic class scheduling, their course offerings are very similar. Table 4 shows community demographics. Table 5 shows school demographics.

Table 4

Demographic Information on Communities

		Community		
		1	2	3
Population	(2006)	59,866	44,191	13,933
Median income	(2005)	$36,600	$31,500	$25,200
Persons below poverty	(1999)	15.9%	17.1%	19.4%
Minority population	(2005)	11.0%	7.3%	5.3%

Note. Demographic data from city-data.com (2008).

Table 5

Demographic Information on Schools

	Ann Whitney	Willis	Ernest
2007 Total enrollment	2,523	1878	760
2007 Population breakdown			
Caucasian	81.8%	88.9%	92.3%
African American	11.7%	7.0%	4.6%
Hispanic	4.4%	2.4%	1.4%
Asian	2.1%	1.5%	1.3%
Other	0.0%	0.1%	0.0%
Male	52.2%	53.2%	52.3%
Female	47.8%	46.8%	47.7%
2007 Low-socioeconomic status	34.6%	26.3%	33.2%
2007 Graduation rate	94.3%	89.4%	86.6%

Note. Demographic data from School Improvement Plans (2007).

Curriculum and Instrumentation

Algebra II courses throughout the state of Tennessee are required to include the course objectives as stated in the curriculum adopted by the Tennessee Department of Education. These objectives are monitored by local school systems to ensure that all students receive an equitable education. Upon course completion, all students should have been taught the same course content, regardless of the school schedule.

The ACT Assessment, formerly American College Testing, is a widely-used exam to assess the educational level of high school students and their ability to complete college-level work. The exam is written in a multiple-choice format and assesses four skill areas: English, mathematics, reading, and science. For the purpose of this study, only the mathematics subtest was used. Each subtest, as well as the composite score, is on a scale of 1 to 36, with 1 the lowest and 36 the highest score. The number of items correct on the subtest is the raw score, which is then converted to a scaled score. Scaled scores have the same meaning for all versions of the ACT Assessment exam offered on different dates. The mathematics subtest is comprised of 60 questions: (24) Pre-Algebra/Elementary Algebra, (18) Intermediate Algebra/Coordinate Geometry, and (18) Plane Geometry/Trigonometry. The ACT Assessment has been administered to high school students for four decades; research has shown that performance on the ACT is directly related to a student's success in college (ACT, Inc., 2008). A study conducted by the ACT Research division determined that ACT Assessment composite scores were indeed a predictor of first year college grade point average (GPA) levels (Noble & Sawyer, 2002). Richard L. Ferguson, chief executive of ACT in 2006, stated that high schools need to encourage more students to take challenging courses, and that ACT, Inc. endorses a curriculum that includes four years of English and three years of mathematics, science, and social studies (Farrell, 2006).

In recent years, there has been an increased focus in education on the importance of preparing all students for college and work (ACT, Inc., 2006). Tennessee joins many states that mandate the ACT Assessment for all high school juniors. One advantage of mandatory testing is that it helps students understand the importance of academic planning and preparation (ACT, Inc., 2006). Students prepared to take the ACT Assessment as juniors will likely continue along a path to college with a rigorous course-load in their senior year, thus preparing them for collegiate academics. It has been stated that through statewide ACT Assessment administration, students are provided with an opportunity to identify academic strengths and weaknesses, explore educational and career interests, and prepare to meet their educational goals. In addition, there is an increased awareness among educators as to the importance of academic planning and achievement (ACT, Inc., 2006).

Assumptions

It is assumed, for the purpose of this study, that the students included in the population had the ability to be successful in an Algebra II course. It is also assumed that each student performed to the best of his/her ability on the ACT Assessment mathematics content test.

Reliability and Validity

Marshak (1997) states that reliability is the ability of research instruments to produce accurate data and that validity is the assurance that the data do, in fact, measure what the researcher says they should measure. ACT, Inc. conducts scholarly research on a variety of topics including test reliability and validity. The ACT Assessment test has been determined to be both reliable, with the mathematics test having a reliability of .91, and valid in terms of assessing a student's learned knowledge throughout high school as well as a predictor of college level achievement (ACT, Inc., 2008).

Procedures

Permission for this study was granted by the head administrator at each high school as well as the office responsible for research for each school system. The demographic data was collected from the Tennessee Department of Education, Assessment, Evaluation, and Research (2008A) website; each school administrator provided a copy of the school's School Improvement Plan.

Student data was collected with assistance from the guidance department, assistant administrators at each school, and central office staff. It was first necessary to identify students in the 2008 graduating class who completed Algebra II and then determine the date of their ACT Assessment administration. After the students who completed Algebra II were identified, a SASI spreadsheet was used and student files were searched to determine the date of ACT Assessment testing.

Data Processing and Analysis

A Crosstabulation and Chi-Square test were used to determine the similarity of school population included in the study. Both Crosstabulations and Pearson Chi-Square tests for socioeconomic status and gender are represented. The strength of the relationship for socioeconomic status (disadvantaged) was determined by Cramér's V; the strength of the relationship for gender was determined by Phi. The data for this analysis was retrieved from Table 5. Two one-way analysis of variance (ANOVA) models were conducted to evaluate differences in means for the end-of-course grades and mathematics content scores on the ACT Assessment test. A Pearson Correlation was used to determine if a relationship exists between Algebra II grades and ACT mathematics scores, and a Crosstabulation and Chi-Square test was used to determine if there was a significant difference in types of teaching schedules and enrollment in Trigonometry. The strength of this relationship was determined by Cramér's V.

Research Questions and Null Hypotheses

Seven null hypotheses were used to answer the four research questions:

1. Is there a significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule?

   H_o1_1: There is no significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

2. Is there a significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4)

block schedule, and those who completed Algebra II on a traditional year-long schedule?

H_o2_1: There is no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

3. Is there a relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics?

H_o3_1: There is no relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

H_o3_2: Among students who completed Algebra II on a one-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

H_o3_3: Among students who completed Algebra II on a two-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

H_o3_4: Among students who completed Algebra II on a traditional year-long schedule, there is no relationship between their end-of-course grade in

Algebra II and their performance on the ACT Assessment score in mathematics.

4. Is there a difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation of teaching schedule?

H_o4_1: There is no difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation of teaching schedule.

A one-way analysis of variance (ANOVA) was conducted to evaluate null hypotheses H_01_1 and H_02_1. Statistical significance was determined by $\alpha = 0.05$. Where the *p* value calculated from the ANOVA is less than 0.05, a statistically significant difference is indicated in the means. Where the *p* value is greater than or equal to 0.05, no significant difference is indicated in the means, as determined from end-of-course grades and ACT Assessment mathematics content scores among the three groups. If a significant difference is determined, Levene's test of Equality will be used to determine which post-hoc test to use.

The end-of-course grades for the populations were converted into an interval scale where A = 4.0, B = 3.0, C = 2.0, D = 1.0, and F = 0.0. Then, the mean was calculated. Through statistical analysis with the use of a one-way ANOVA, it was determined whether or not statistically significant differences occur among Algebra II end-of-course grades of students at Ann Whitney High School, Willis High School, and Ernest High School. The ACT scores were represented on an interval scale using the scaled scores of 1 to 36. A one-way ANOVA was conducted to determine statistically significant differences among the mean ACT Assessment mathematics content scores for students at Ann Whitney High School, Willis High School, and Ernest High School.

A Pearson Correlation was used to determine if a relationship exists between the Algebra II end-of-course grades and ACT Assessment mathematics scores. The correlation coefficient (r) was squared to determine what percentage of variance was accounted for by the end-of-course grades. The predictor variable for this study was the end-of-course grade; the criterion variable for this study was the mathematics score on the ACT Assessment.

A Crosstabulation and Chi-Square test were used to determine if a statistically significant difference occurred among teaching schedules and enrollment in Trigonometry. The strength of the relationship was determined by Cramér’s V.

Summary

This research study has identified three teaching schedules for Algebra II in three high schools in northeast Tennessee. A one way analysis of variance (ANOVA) was conducted to determine if there was a statistical difference among end-of-course grades for each schedule and ACT Assessment mathematics content scores for each schedule. In addition, a Pearson Correlation was used to determine the strength of a relationship between end-of-course grades and ACT Assessment mathematics content scores for each schedule. Additionally, a Crosstabulation and Chi-Square test were used to determine statistically significant differences in teaching schedules and enrollment in Trigonometry.

CHAPTER FOUR: FINDINGS

Purpose of the Study

The purpose of this ex post facto study was to determine if there were statistically significant differences among end-of-course grades in Algebra II and mathematics content scores on the ACT Assessment, based on the types of teaching schedule at three high schools in northeast Tennessee: (1) a one-semester accelerated (4x4) block schedule at Ann Whitney High School; (2) a two-semester accelerated (4x4) block schedule at Willis High School and; (3) a traditional year-long schedule at Ernest High School. Additionally, this study was conducted to examine the relationship among end-of-course grades in Algebra II and mathematics content scores on the ACT Assessment for all study participants, as well as for each type of teaching schedule. Finally, an analysis was conducted to determine if there were differences among the three types of teaching schedules and whether or not students continued their mathematics education by taking Trigonometry.

The data for this study was collected through the use of SASI (Student Administration System Information) and student records. Two of the schools selected for the study utilize electronic databases for student grades and other information. While Ann Whitney High School uses SASI, ACT Assessment scores are not recorded in the database. So, student records were utilized in gathering those scores, which were then added to the spreadsheet of end-of-course grades generated by SASI. Willis High School also uses SASI and includes ACT Assessment data as well as end-of-course grades in the database. Ernest High School maintains all student records in a file cabinet in the guidance office. The files were well organized, with all information needed for this study included on a card in the front of each file. Through coding of data, all students in the study remained anonymous.

The 2008 graduating class at Ann Whitney High School numbered 447, Willis High School numbered 338, and Ernest High School had a graduating class of 186. Between 33% and 54% of each graduating class met the criteria for the study. There were 333 students at Ann Whitney High School, 212 students at Willis High School, and 129 students at Ernest High School who took Algebra II on the predominant teaching schedule at each school. After data were collected and the end-of-course Algebra II grades and ACT Assessment mathematics content scores were examined, it was determined that 193 students from Ann Whitney High School, 114 students from Willis High School, and 101 students from Ernest High School qualified for the study.

There were an additional 84 students enrolled in Algebra II-Terminal on a one-semester block schedule at Willis High School who received Algebra II credit but were not included in this study, because the nature of the course taken did not allow them to continue with additional mathematics courses. However, in order to state the total percentage of students at each school who were enrolled in Algebra II, these students were added to the 212 students who took the course on a two-semester block schedule. The other two high schools did not offer an alternative Algebra II course. A total of 74.5% of the students at Ann Whitney High School, 87.6% of the students at Willis High School, and 69.5% of the students at Ernest High School were enrolled in an Algebra II mathematics course while in high school.

After collection, the data were calculated using SPSS (the Statistical Package for the Social Sciences). A Crosstabulation and Chi-Square test were used to determine the similarity of school populations included in the study. Both Crosstabulations and Chi-Square tests for socioeconomic status and gender are represented in this chapter. Two one-way analysis of variance (ANOVA) models were conducted to evaluate the differences in means for end-of-course grades among the three school schedules and mathematics content scores on the ACT Assessment test among the three school schedules.

Where a significant difference existed, Levene's Test of Equality of Error Variance was used to determine which post hoc test to use for further evaluation. In this case, a Dunnett post hoc test was used to determine statistical differences in the means for the three teaching schedules. A Pearson Correlation was used to determine if there was a relationship between end-of-course grades and ACT Assessment mathematics content scores; r^2 was calculated to determine what percentage of variance of the dependent variable was accounted for by the independent variable. Research question 4 was evaluated using a Crosstabulation and Chi-Square test to determine if a statistically significant difference occurred, then, Cramér's V was used to determine the strength of the relationship.

Socioeconomic status and gender were used to determine similarity in school populations. Socioeconomic status was defined as disadvantaged or not disadvantaged based on whether or not students participated in the free or reduced meals program. In order to evaluate whether or not there were differences among the three schools regarding socioeconomic status, a 3 by 2 Crosstabulation and Chi-Square test were used. Prior to the test, chi-square assumptions were checked, with no more than 20% of the cells having a frequency of less than 5; the minimum expected count must be at least 1 (Howell, 2008). None of the cells had an expected count less than 5, and the minimum expected count was 235.32. Therefore, there were no violations of assumptions of chi-square.

The chi-square showed a statistically significant difference in the percentage of disadvantaged students at the three high schools, χ^2 (2, n = 5748) = 11.58, $p < .01$. However, the strength of the relationship between school and socioeconomic status, as measured by Cramér's V, was weak (.05). Among students who attended Ann Whitney High School, 28.1% were classified as disadvantaged, compared to 32.5% at Willis High School and 28.7% at Ernest High School (see Table 6). Even though the chi-square showed a statistically significant difference among the schools' percentage of disadvantaged students, the actual difference in percentages was substantively unimportant, with only 4.4 percentage points separating the schools with the lowest and highest percentage of disadvantaged students. The statistically significant finding of the chi-square test was clearly the result of the large sample size (n = 5748) and not a substantive difference in each school's percentage of disadvantaged students.

A 3 by 2 Crosstabulation and Chi-Square test were used to determine whether or not the three schools used in this study differed in the percentage of male and female students. None of the cells had an expected count less than five, and the minimum expected count was 375.27. Therefore, there were no violations of assumptions of chi-square.

As determined by the chi-square test, there were no differences in each school's percentage of male and female students, χ^2 (2, n = 5748) = 0.52, p = .77. The strength of the relationship as measured by Cramér's V, showed virtually no relationship between school and gender (.01).

Table 6

Crosstabulation Table for Socioeconomic Status by School

	Ann Whitney		Willis		Ernest	
SES	*n*	%	*n*	%	*n*	%
Disadvantaged	816	28.1	667	32.5	227	28.7
Not Disadvantaged	2088	71.9	1386	67.5	564	71.3
Total	2904	100	2053	100	791	100

As shown in Table 7, the percentage of males and females for the three schools were almost identical.

Table 7

Crosstabulation Table for Gender by School

	Ann Whitney		Willis		Ernest	
Gender	*n*	%	*n*	%	*n*	%
Male	1515	52.2	1092	53.2	414	52.3
Female	1389	47.8	961	46.8	377	47.7
Total	2904	100	2053	100	791	100

Research Question One

Research Question 1. Is there a significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule?

H_o1_1: There is no significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

A one-way analysis of variance (ANOVA) was conducted to test the null hypothesis that there is no significant difference in the end-of-course grades in Algebra II among students who completed Algebra II on a one-semester block schedule, a two-semester block schedule, and a traditional year-long schedule. The dependent (test) variable was the end-of-course grades in Algebra II. The independent (grouping) variable, type of teaching schedule, had three levels: (1) accelerated (4x4) one-semester block schedule, (2) accelerated (4x4) two-semester block schedule, and (3) traditional schedule. The one-way ANOVA was significant, F (2, 405) = 12.04, MSE = 1.25, $p <$ .01. Therefore, the null hypothesis was rejected.

The strength of the relationship, as measured by η^2, between the type of teaching schedule and end-of-course grades in Algebra II was medium (.06). In other words, 6% of the variance in end-of-course grades in Algebra II was accounted for by the type of teaching schedule.

Because the overall F test from the ANOVA model was significant, post hoc multiple pairwise comparisons were conducted, to determine which pair or pairs of means were different. The Dunnett post hoc test, which does not assume equal variances, was selected because the Levene's test showed that equal variances could not be assumed, F (2, 405) = 5.55, $p < .01$.

The Dunnett procedure showed there was no difference in the end-of-course grades in Algebra II between students on an accelerated (4x4) one-semester block schedule and students on an accelerated (4x4) two-semester block schedule (*p* = .65). However, the mean end-of-course Algebra II grades for students on a traditional teaching schedule was significantly higher than the mean for students on an accelerated (4x4) one-semester teaching schedule ($p < .01$), as well as the mean for students on an accelerated (4x4) two-semester teaching schedule ($p < .01$).

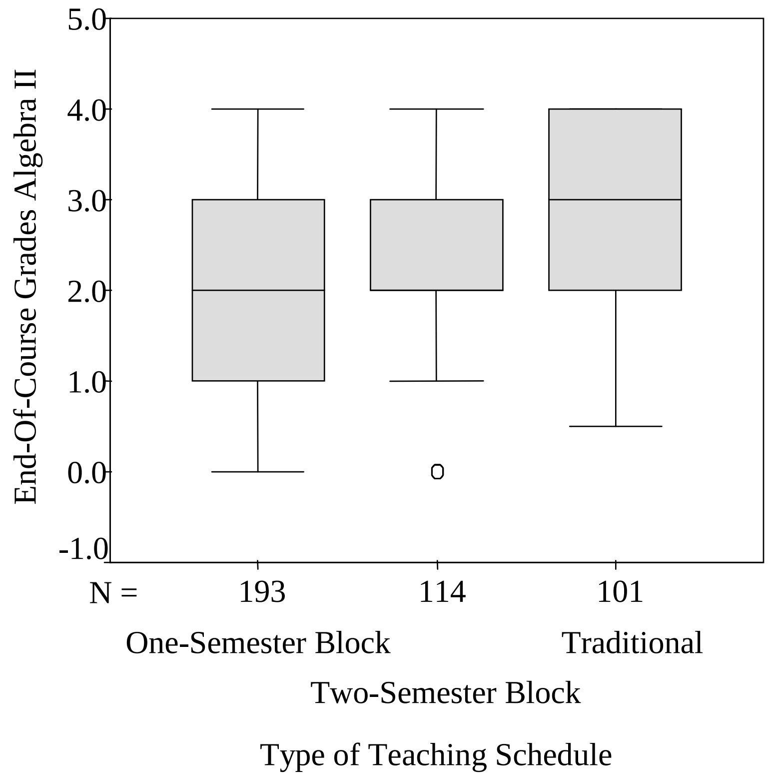
There appears to be little difference in the end-of-course grades in Algebra II between students on the one- and two-semester block schedules, while students on a traditional teaching schedule performed better in Algebra II than their counterparts on accelerated block teaching schedules.

The means and standard deviations for the end-of-course grades by the type of teaching schedule are shown in Table 8; Figure 1 shows the boxplot for the distribution of end-of-course grades for each type of teaching schedule.

Table 8

Means and Standard Deviations for End-of-Course Grades in Algebra II by Type of Teaching Schedule

Type of Teaching Schedule	*n*	*M*	*SD*
One-Semester Block	193	2.16	1.24
Two-Semester Block	114	2.82	0.97
Traditional	101	2.36	1.02
Total	408	2.36	1.15



o = an observation between 1.5 times to 3.0 times the interquartile range

Figure 1. Boxplot for end-of-course grades in math, by type of teaching schedule.

Research Question Two

Research Question 2. Is there a significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule?

H_o2_1: There is no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.

A one-way analysis of variance (ANOVA) was conducted to test the null hypothesis that there is no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester block schedule, a two-semester block schedule, and a traditional year-long schedule. The dependent (test) variable was the ACT Assessment mathematics content scores. The independent (grouping) variable, type of teaching schedule, had three levels: (1) accelerated (4x4) one-semester block schedule, (2) accelerated (4x4) two-semester block schedule, and (3) traditional schedule. The one-way ANOVA was not significant, F (2, 405) = 1.93, p = .15. Therefore, the evaluation failed to reject the null hypothesis.

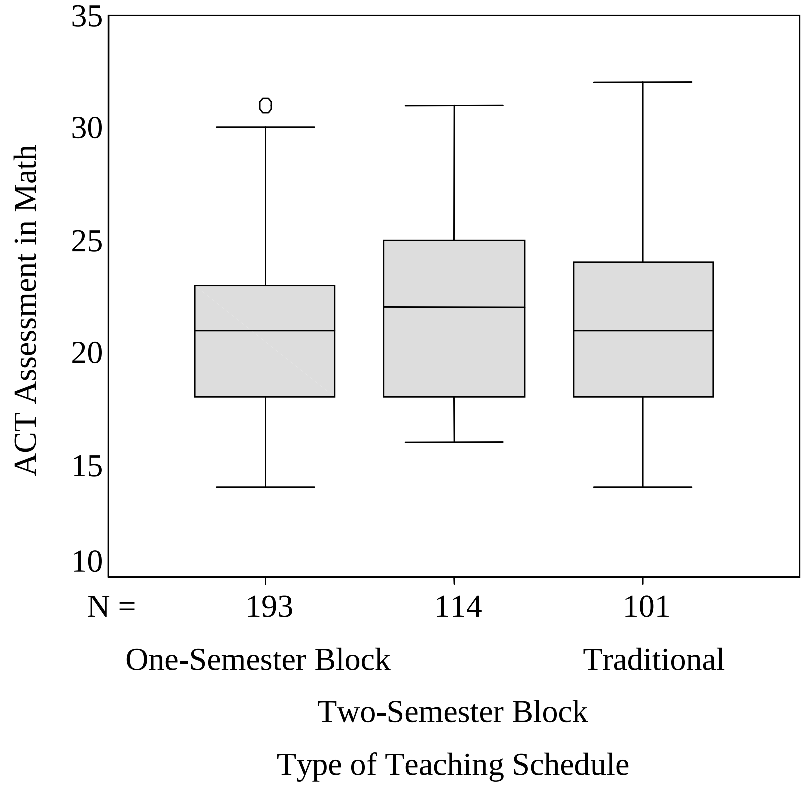
The strength of the relationship, as measured by η^2, between the type of teaching schedule and the ACT Assessment mathematics content scores was small (.01). In other words, only 1% of the variance in the ACT Assessment mathematics content scores was accounted for by the type of teaching schedule. Examination of the means showed less than one point difference for each pair of means.

The means and standard deviations for the ACT Assessment mathematics content scores by the type of teaching schedule are shown in Table 9; Figure 2 shows the boxplot for the ACT Assessment in mathematics scores for each type of teaching schedule.

Table 9

Means and Standard Deviations for ACT Assessment in Math by Type of Teaching Schedule

Type of Teaching Schedule	*n*	*M*	*SD*
One-Semester Block	193	20.82	3.71
Two-Semester Block	114	21.69	3.71
Traditional	101	21.26	4.08
Total	408	21.17	3.81



o = an observation between 1.5 times to 3.0 times the interquartile range

Figure 2. Boxplot for ACT Assessment in Math by type of teaching schedule.

Research Question Three

Research Question 3. Is there a relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics?

H_o3_1: There is no relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

A Pearson Correlation was conducted to test the null hypothesis that there is no relationship between a student's end-of-course grade in Algebra II and their ACT Assessment score in mathematics. For all students (N = 408) who participated in the study, the correlation between Algebra II end-of-course grades and ACT Assessment mathematics content scores showed a moderate positive relationship (.44), which was significant at the .01 level. Therefore, the null hypothesis was rejected.

Higher end-of-course Algebra II grades were associated with higher ACT Assessment mathematics content scores. The r^2 was .19, which showed that 19% of the variance in ACT Assessment mathematics scores was accounted for by end-of-course grades in Algebra II.

Figure 3 shows the scatterplot for the Algebra II end-of-course grades and ACT Assessment in mathematics scores for all students in the study. The prediction equation for the linear regression line is Y = 17.75 + 1.45(X) and may be used for additional research.

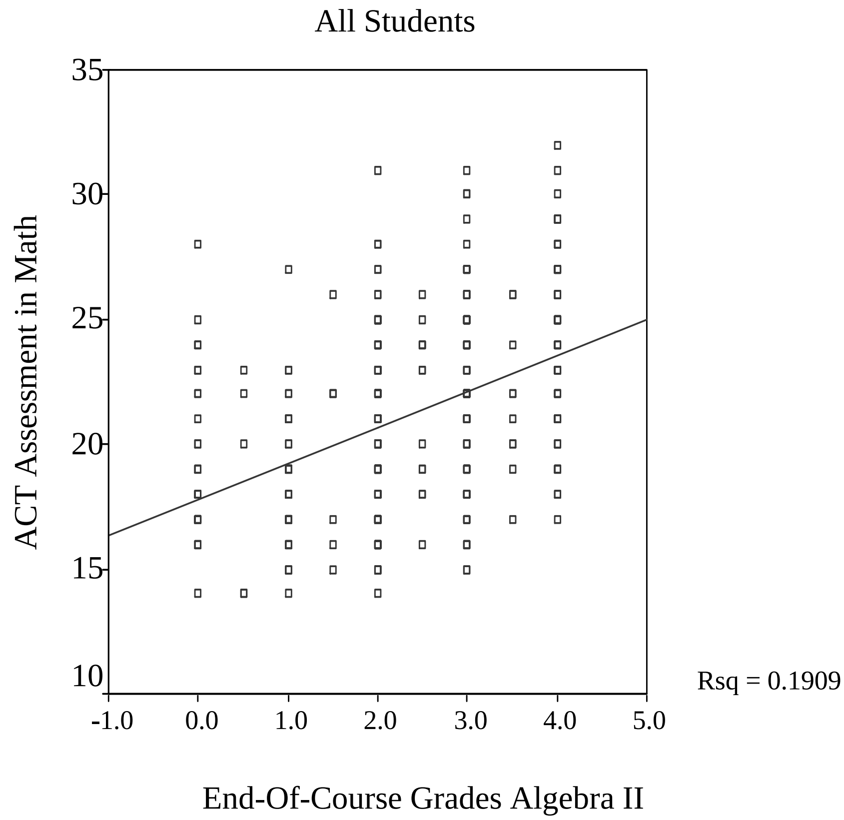


Figure 3. Scatterplot for end-of-course grades for Algebra II and ACT Assessment in Mathematics scores for all students.

H_o3_2: Among students who completed Algebra II on a one-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

A Pearson Correlation was conducted to test the null hypothesis that there is no relationship between the end-of-course grades in Algebra II and ACT Assessment scores in mathematics for students on a one-semester block schedule. For students (n = 193) completing Algebra II on a one-semester block schedule who participated in the study, the correlation between Algebra II end-of-course grades and ACT Assessment mathematics content scores showed a moderate positive relationship (.49), which was significant at the .01 level. Therefore, the null hypothesis was rejected.

Higher end-of-course Algebra II grades were associated with higher ACT Assessment mathematics content scores. The r^2 was .24, which showed that 24% of the variance in ACT Assessment mathematics scores was accounted for by end-of-course grades in Algebra II.

Figure 4 shows the scatterplot for the Algebra II end-of-course grades and ACT Assessment in mathematics scores for students completing Algebra II on a one-semester block schedule. The prediction equation for the linear regression line is Y = 17.71 + 1.44(X) and may be used for additional research.

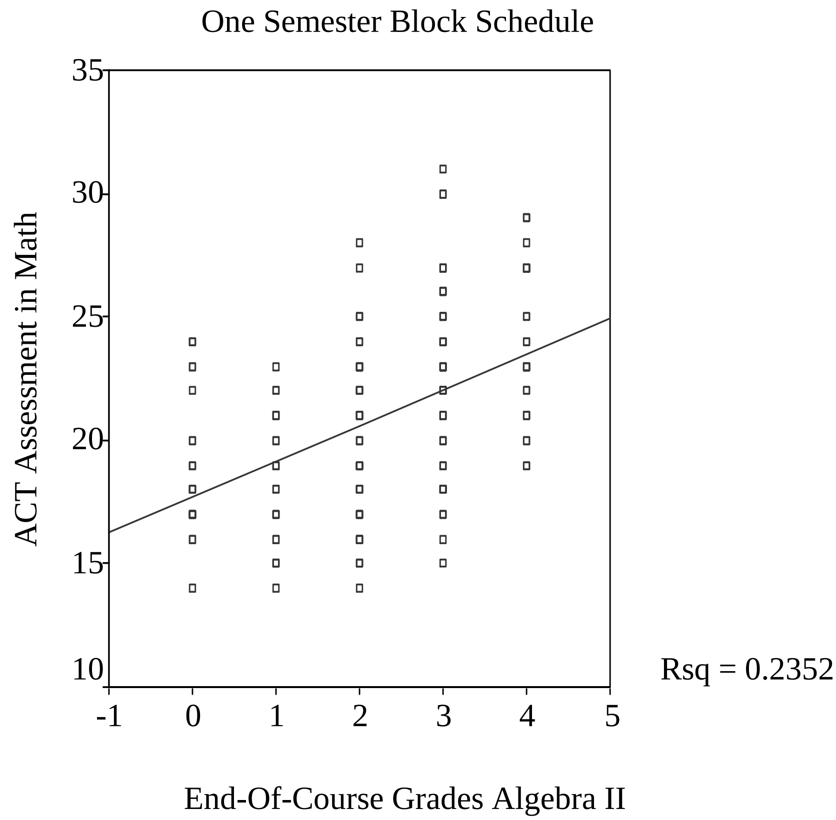


Figure 4. Scatterplot for end-of-course grades for Algebra II and ACT Assessment in Mathematics scores for students completing Algebra II on a one-semester block schedule.

H_o3_3: Among students who completed Algebra II on a two-semester block schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

A Pearson Correlation was conducted to test the null hypothesis that there is no relationship between the end-of-course grades in Algebra II and ACT Assessment scores in mathematics for students on a two-semester block schedule. For students (n = 114) completing Algebra II on a two-semester block schedule who participated in the study, the correlation between Algebra II end-of-course grades and ACT Assessment mathematics content scores showed a moderate positive relationship (.30), which was significant at the .01 level. Therefore, the null hypothesis was rejected.

Higher end-of-course Algebra II grades were associated with higher ACT Assessment mathematics content scores. The r^2 was .09, which showed that 9% of the variance in ACT Assessment mathematics scores was accounted for by end-of-course grades in Algebra II.

Figure 5 shows the scatterplot for the Algebra II end-of-course grades and ACT Assessment in mathematics scores for students completing Algebra II on a two-semester block schedule. The prediction equation for the linear regression line is Y = 19.09 + 1.14(X) and may be used for additional research.

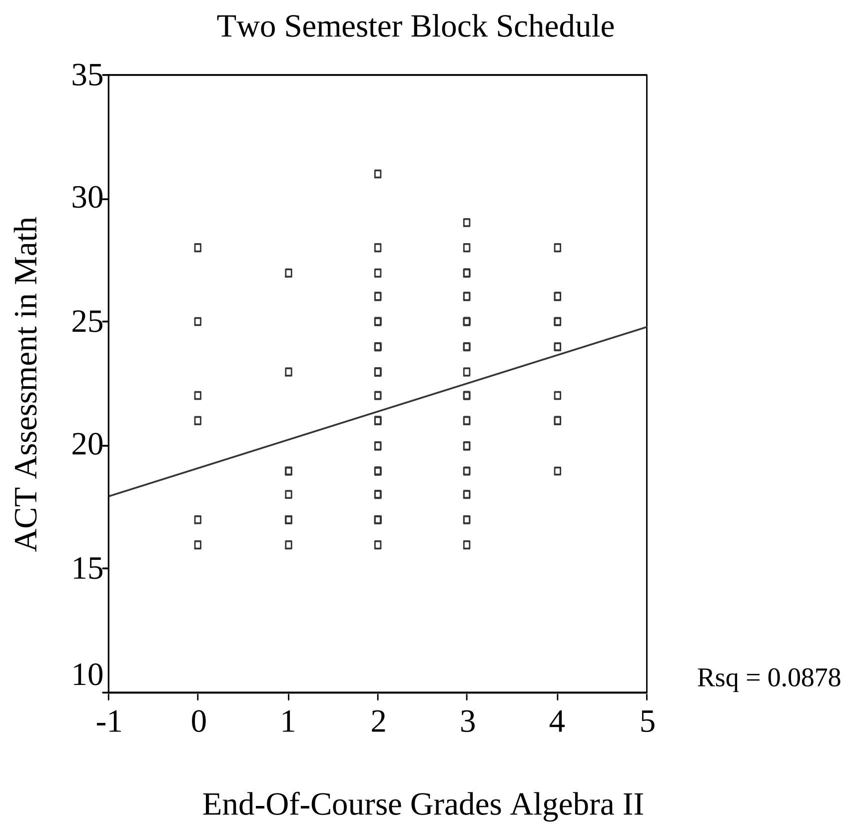


Figure 5. Scatterplot for end-of-course grades for Algebra II and ACT Assessment in Mathematics scores for students completing Algebra II on a two-semester block schedule.

H_o3_4: Among students who completed Algebra II on a traditional year-long schedule, there is no relationship between their end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics.

A Pearson Correlation was conducted to test the null hypothesis that there is no relationship between the end-of-course grades in Algebra II and ACT Assessment scores in mathematics for students on a traditional year-long schedule. For students (n = 101) completing Algebra II on a traditional schedule who participated in the study, the correlation between Algebra II end-of-course grades and ACT Assessment mathematics content scores showed a moderate positive relationship (.52), which was significant at the .01 level. Therefore, the null hypothesis was rejected.

Higher end-of-course Algebra II grades were associated with higher ACT Assessment mathematics content scores. The r^2 was .27, which showed that 27% of the variance in ACT Assessment mathematics scores was accounted for by end-of-course grades in Algebra II.

Figure 6 shows the scatterplot for the Algebra II end-of-course grades and ACT Assessment in mathematics scores for students completing Algebra II on a traditional schedule. The prediction equation for the linear regression line is Y = 15.44 + 2.06(X) and may be used for additional research.

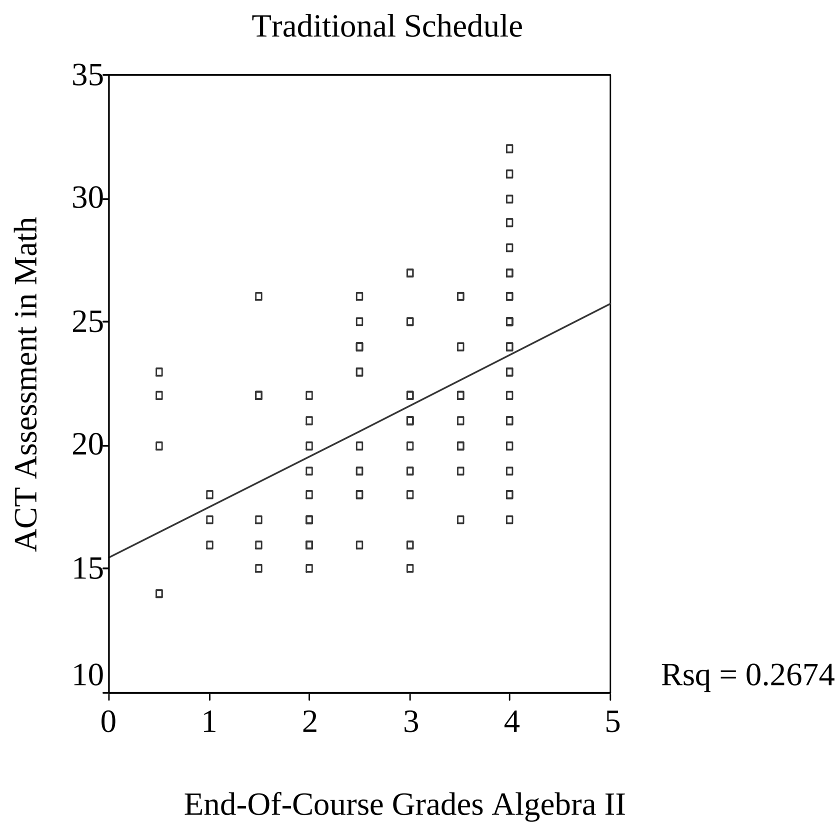


Figure 6. Scatterplot for end-of-course grades for algebra II and ACT Assessment in Math scores for students completing Algebra II on a traditional schedule.

Research Question Four

Research Question 4. Is there a difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation in schedule?

H_o4_1: There is no difference in percentage of students who continue their mathematics education by enrolling in a Trigonometry course for each variation in schedule.

A 3 by 2 Crosstabulation and Chi-Square test were used to test the null hypothesis that there is no difference between teaching schedules and the percentage of students who continue their mathematics education by enrolling in a Trigonometry course. Since none of the cells had an expected count less than 5 and the minimum expected count was 60.86, there were no violations of assumptions of chi-square. As determined by the chi-square test, there was a significant difference in the type of teaching schedule and enrollment in Trigonometry, χ^2 (2, n = 674) = 30.96, $p < .01$. Therefore, the null hypothesis was rejected.

The strength of the relationship between teaching schedule and enrollment in Trigonometry, as measured by Cramér's V, was weak but definite (.21).

As shown in Table 10, of the students who completed Algebra II on a one-semester block schedule, 41.4% continued to Trigonometry, while 62.7% of the students on a two-semester block schedule, and 36.4% of the students on a traditional schedule chose to enroll in Trigonometry.

Table 10

Crosstabulation Table for Enrollment in Trigonometry by Type of Teaching Schedule

	One-Semester Block		Two-Semester Block		Traditional	
Trigonometry	*n*	%	*n*	%	*n*	%
No	195	58.6	79	37.3	82	63.6
Yes	138	41.4	133	62.7	47	36.4
Total	333	100	212	100	129	100

Summary

A 3 by 2 Crosstabulation and Chi-Square test were used to evaluate differences among the three high schools chosen for the study, with regard to socioeconomic status. A statistically significant difference was shown. The strength of the relationship, as measured by Cramér's V, was weak (.05). Even though a significant difference was calculated, there was little difference in the percentages in the three schools.

The male and female populations in the three high schools chosen for the study were examined using a 3 by 2 Crosstabulation and Chi-Square test. No statistically significant differences were found. The strength of the relationship, as measured by Cramér's V, showed virtually no relationship between school and gender (.01).

A one-way analysis of variance (ANOVA) was used to answer research question one where the null hypothesis was rejected. (H_o1_1 – There is no significant difference in the end-of-course grades in Algebra II among students who complete Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.) The strength of the relationship between the type of teaching schedule and end-of-course grades in Algebra II was medium (.06). In other words, 6% of the variance in end-of-course grades in Algebra II was accounted for by the type of teaching schedule. The highest mean grades were earned by students who took the course on a traditional schedule, the next highest mean grades were for students who took the course on a two-semester block schedule, and the lowest mean grades were earned by students on the one-semester block schedule.

The ANOVA used for research question two failed to reject the null hypothesis. (H_o2_1 – There is no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on a one-semester accelerated (4x4) block schedule, students who completed the course on a two-semester accelerated (4x4) block schedule, and those who completed Algebra II on a traditional year-long schedule.) When examining the difference of means, there is less than 1.0 difference among all comparisons, and no significant difference in the ACT Assessment scores in mathematics among students who completed Algebra II on any of the three schedules. The highest mean scores achieved were by students on the two-semester block schedule, while students on a year-long traditional schedule achieved the next highest mean scores, and the one-semester block schedule students had the lowest mean ACT Assessment mathematics scores.

A Pearson Correlation was conducted to test research question three and its four null hypotheses concerning grades and mathematics scores on the ACT Assessment test among the total population and the three types of teaching schedules. Each analysis indicated a positive relationship and all null hypotheses were rejected.

Null hypothesis H_o3_1 – There is no relationship between a student's end-of-course grade in Algebra II and their performance on the ACT Assessment score in mathematics – was rejected with a moderate positive relationship of (.44).

Null hypothesis H_o3_2 – There is no relationship between the mean end-of-course grades in Algebra II and ACT Assessment scores in mathematics, among students who completed Algebra II on a one-semester block schedule – was rejected with a moderate positive relationship of (.49).

Null hypothesis H_o3_3 – There is no relationship between the end-of-course grades in Algebra II and ACT Assessment scores in mathematics, among students who completed Algebra II on a two-semester block schedule – was rejected with a moderate positive relationship of (.30).

Null hypothesis H_o3_4 – There is no relationship between the end-of-course grades in Algebra II and ACT Assessment scores in mathematics, among students who completed Algebra II on a traditional year-long schedule – was rejected with a moderate positive relationship of (.52).

A 3 by 2 Crosstabulation and Chi-Square test were used to answer research question four. The null hypothesis, H_04_1: There is no difference between teaching schedules and the percentage of students who continue their mathematics education by enrolling in a Trigonometry course, was rejected, as a significant difference was determined in the type of teaching schedule and enrollment in Trigonometry. The strength of the relationship between teaching schedule and enrollment in Trigonometry, as measured by Cramér's V (.21), was weak but definitely indicated a relationship between teaching schedules and the number of Algebra II students who continue their mathematics education by taking Trigonometry. The teaching schedule that produced the largest percentage of students enrolling in Trigonometry was the two-semester block schedule, at 62.7%, followed by the one-semester block schedule, at 41.4%, and the traditional schedule, at 36.4%.

CHAPTER FIVE: SUMMARY, CONCLUSIONS, & RECOMMENDATIONS

Summary

Chapter one of this dissertation presents introductory background information and the purpose of this study. Chapter two includes a review of literature concerned with block and traditional scheduling, as well as literature and research about mathematics courses taught on both of these schedules. Chapter three explains the methodology used to gather and analyze data for this study. Chapter four reports the results of the data collection and statistical analysis of the data. And, this chapter five consists of conclusions that can be made from the study, with implications for further research.

Introduction

School scheduling has been discussed and debated in the United States for several decades. In the 1980s, states began to increase requirements for graduation, which led to exploration of alternate school schedules. Until then, the school-day had remained unchanged since its conception (Canady & Rettig, 1995). Block scheduling, which first came into being and was strongly rejected during the 1960s, became a popular choice for alternative school schedules during the late 1980s and 1990s. For many schools, it was the answer to their dilemma, since the greatest strength of block scheduling is its flexibility and adaptability (Hottenstein, 1998). Today, more than 50% of all high schools use some type of block scheduling, not only to gain educational instruction time, but to address accountability demands, reduce discipline problems, enhance learning through longer classes, and improve test scores (Gruber & Onwuegbuzie, 2001).

Purpose

The purpose of this ex post facto study was to determine if there were statistically significant differences among end-of-course grades in Algebra II and mathematics content scores on the ACT Assessment at three high schools in northeast Tennessee, by comparing a one-semester accelerated (4x4) block schedule at Ann Whitney High School, a two-semester accelerated (4x4) block schedule at Willis High School, and a traditional year-long schedule at Ernest High School. In addition, the study examined the relationship among Algebra II end-of-course grades and ACT Assessment mathematics content scores for participants, as well as for each teaching schedule. An analysis was also conducted to determine differences among the three teaching schedules and the number of students who continued their mathematics education by taking Trigonometry.

Participants

The participants for this study included students enrolled in three high schools in northeast Tennessee; the population was the graduating class of 2008 at each high school. Those students participating in the study took the ACT Assessment within a semester of Algebra II course completion. For those students who chose not to continue their mathematics education beyond Algebra II, the first ACT Assessment mathematics content score after completion of Algebra II was used for the study. These high schools were chosen because of the similarity of their districts, as each school is the single public high school within the city limits of the town where they are located.

The data for this study was collected through the use of SASI (Student Administration System Information) and student records. Two of the schools selected for the study utilize electronic databases for student grades and other information. While Ann Whitney High School uses SASI, ACT Assessment scores were not recorded in the database. So, student records were utilized in gathering those scores, which were then added to the spreadsheet of end-of-course grades generated by SASI. Willis High School also uses SASI and includes ACT Assessment data as well as end-of-course grades in the database. Ernest High School maintains all student records in a file cabinet in the guidance office. The files were well organized, with all information needed for this study included on a card in the front of each file. Through coding of data, all students in the study remained anonymous.

Ann Whitney High School’s 2008 graduating class numbered 447, of which 333 (74.5%) completed Algebra II; Willis High School graduated 338, with 212 taking Algebra II and 84 students enrolled in Algebra II-Terminal (87.6%); and Ernest High School’s 2008 graduating class of 186 included 129 (69.5%) students who took Algebra II. After data were collected, and the end-of-course Algebra II grades and ACT Assessment mathematics content scores were examined, it was determined that 193 students from Ann Whitney High School, 114 students from Willis High School, and 101 students from Ernest High School qualified for the study.

The students at Willis High School who were enrolled in Algebra II-Terminal on a one-semester block schedule were not included in the study because, even though they received Algebra II credit, the nature of the course taken did not allow them to continue with additional mathematics courses. These students were, however, included in the total percentage of students enrolled in Algebra II on a two-semester block schedule. The other two high schools did not offer an alternative Algebra II course.

Methods

After collection, the data were calculated using SPSS (the Statistical Package for the Social Sciences). A Crosstabulation and Chi-Square test were used to determine the similarity of school populations included in the study; the results are represented in chapter four. After using a Crosstabulation and Pearson Chi-Square test to analyze the data, Cramér's V or Phi was used to determine the strength of the relationship. Seven null hypotheses were used to answer the four research questions. Two of the null hypotheses were analyzed using a one-way analysis of variance (ANOVA) to evaluate and determine if there was a statistically significant difference in the means of end-of-course grades and mathematics content scores on the ACT Assessment test.

Where a significant difference existed, Levene's Test of Equality of Error Variance was used to determine which post hoc test to use for further evaluation. As a result, the Dunnett post hoc test was used to determine statistical differences in the means for the three teaching schedules. Four null hypotheses were evaluated using Pearson Correlation and r^2 was calculated to determine what percentage of variance in the ACT Assessment mathematics content score was accounted for by the student's Algebra II end-of-course grade. The seventh null hypothesis was evaluated using a Crosstabulation and Pearson Chi-Square test. This analysis was followed by Cramér's V to determine the strength of the relationship.

When comparing school populations, it was important to examine the percentage of low socioeconomic students. For the three schools involved in the study, the percentage of disadvantaged verses non-disadvantaged student population at each school was very similar. Statistical analysis suggested a significant difference. However, the percentage of disadvantaged students at Ann Whitney High School was 28.1% for those who completed Algebra II on a one-semester block schedule, 32.5% for those who completed Algebra II on a two-semester block schedule at Willis High School, and 28.7% for the students who completed Algebra II on a traditional schedule at Ernest High School.

A little less than one-third of the students at each school were shown to be disadvantaged, which is important because achievement in mathematics is related to socioeconomic status (Lubienski, 2007). The schools were also assessed for similarities related to gender, but there was no significant difference found in the three high schools with regard to this variable. The students who attend these schools all live within a thirty-mile radius; the culture of each community is also similar, where the schools chosen for the study are a mirror of their community.

Results of Research Question 1

The first question investigated in the study was to determine if school scheduling had a significant effect on Algebra II end-of-course grades. The null hypothesis was rejected when results indicated a significant difference, and showed that students who took Algebra II on a traditional schedule earned higher grades. Not only do higher grades have an impact on college entrance, they also impact high school graduation requirements.

In the fifty years since Sputnik, nearly all states have established mathematics content standards (Steen, 2007). The standards provide a guide for specific curriculum to be taught within a course. Students in each state should be taught and tested on the same objectives. In the United States, more than half of the states require at least three years of high school mathematics; three out of four high school graduates complete Algebra II. Tennessee has mandated that, beginning in 2010, all high school graduates will complete Algebra II. I wonder if this is appropriate for all students, even those entering a technical field.

Steen (2007) explains that even though more students take upper-level high school mathematics classes, they do not appear to be more competent in math than their parents were in the early 1970s. Could mandating upper-level mathematics courses encourage students to drop out of high school? According to Steen (2007), about one-third of students in the United States leave high school without a diploma. For many students, failure in high school mathematics is a contributing factor to their lack of a high school diploma. While the grade is important and should not to be given away, it should adequately reflect what the student has learned in class. However, does every student need Algebra II?

Students on a traditional year-long schedule earned the highest grades, and may feel they have an entire school-year to master a class. Therefore, they are able to successfully comprehend the objectives, when the class is taught for 180 days. Students on a two-semester block schedule earned the second highest grades. While these students took Algebra II for the entire school-year, their grades were only an indication of their achievement during the second semester. The lowest mean grades were earned by students on a one-semester block schedule. Could the state curriculum be introduced so fast that the students have trouble retaining concepts?

Standards effective in 2009 increase the learning expectation and depth of knowledge for students enrolled in Algebra II (Tennessee Diploma Project, 2008). Will mandatory enrollment and increased expectations raise the level of mathematics education in Tennessee or will the standards result in an increased dropout rate and GED graduates? The difference between a final grade of F or D in a course will, for some students, make the difference in whether or not they earn a high school diploma. Low-achieving students on a traditional year-long schedule may have a greater chance to complete the requirements for graduation than students on other schedules.

Results of Research Question 2

The second research question investigated was to determine if school scheduling had an effect on ACT Assessment mathematics content scores. Results failed to reject the null hypothesis when statistical analysis showed no significant difference among the ACT Assessment mathematics content scores of the three school schedules. The two-semester block students had the highest mean score, followed by students on a traditional year-long schedule. Students on these schedules took Algebra II for a full year. Mathematics educators in Tennessee are concerned that students are required to score 19 on the ACT Assessment mathematics content area before they are allowed to enroll in

Trigonometry or Statistics as their fourth year of high school mathematics, rather than the required Bridge course.

The Tennessee Department of Education has determined that a score of 22 on the ACT Assessment in mathematics is necessary for success in college (Tennessee Diploma Project, 2008). When examining scores, in terms of mastery level, students included in the study were divided into three groups: (1) students scoring below 19, (2) students scoring 19-21, and (3) students scoring 22 or above. Students in the first group, those scoring below the 19 benchmark, consisted of 27.2% of the students on a two-semester block, 29.7% of those on a traditional year-long schedule, and 32.1% of students on a one-semester block. Students in the second group, those scoring 19-21, consisted of 21% of the students on a two-semester block, 22.8% of those on a traditional year-long schedule, and 25.9% of students on a one-semester block. Students in the third group, those who met the 22 mastery benchmark, consisted of 51.8% of the students on a two-semester block, 47.5% of those on a traditional year-long schedule, and 42.0% of students on a one-semester block. Very-high-achieving students in each school were not included in this study, just as low-achieving and students who chose not to take Algebra II were also excluded. When ACT Assessment in mathematics scores for the entire graduating class of 2008 were examined, the students on a two-semester block earned a mean score of 21.7, those on a traditional year-long schedule earned a mean score of 20.4, and students on a one-semester block earned a mean score of 22.1.

Results of Research Question 3

Research question three was investigated to determine if a correlation exists between the student's end-of-course grade and their performance on the ACT Assessment in mathematics. The four null hypotheses used to answer this research question were all rejected, where each correlation was statistically significant with a positive relationship. For all students included in the study, the correlation was (.44). The strongest relationship (.52) existed among students on a traditional year-long schedule, followed by those on a one-semester block (.49), and then students on a two-semester block (.30). Regardless of the schedule, there was a positive correlation between grades and teaching schedule.

These findings are important information for high school mathematics teachers because, when held accountable for an ACT Assessment score, it is important that educators have an idea of how students are likely to score and determine what skills and concepts they are lacking. Tennessee standards were aligned with the ACT, Inc. standards beginning in 2009, which gives mathematics teachers an opportunity to help students improve their ACT Assessment mathematics content scores by teaching what is expected in the Algebra II course. As ACT scores rise for college admission within Tennessee, classroom teachers must be aware of and understand how to make classroom activities pertinent, so mathematical understanding is increased along with the student's score.

Results of Research Question 4

Research question four examined the difference between teaching schedules and the percentage of students who continued their mathematics education by enrolling in a

Trigonometry course. The null hypothesis was rejected because a significant difference was found among the type of teaching schedule and the number of students choosing to enroll in Trigonometry. The total number of students who took Algebra II at each school was used for this statistical analysis, rather than just those who met the requirements for the other research questions by their date of ACT Assessment administration. Among students who took Algebra II on a one-semester block schedule, 41.4% enrolled in Trigonometry. Among students who completed Algebra II on a traditional year-long schedule, 36.4% enrolled in Trigonometry. And among the students who completed Algebra II on a two-semester block schedule, 62.7% (133 students out of 212) choose to continue their mathematics education by enrolling in Trigonometry.

This result is important because 18 of the 60 questions on the ACT Assessment in mathematics can be included in the Plane Geometry/Trigonometry category. This fact alone, rather than the teaching schedule, may make the biggest difference in total ACT Assessment scores. Perhaps students who complete Algebra II on a two-semester block schedule feel successful in mathematics and confident enough to enroll in another course. By the conclusion of Algebra II, these students have had 105 more hours of instruction than the student on a traditional year-long schedule, and 135 more hours of instruction than students on a one-semester block. That may be the reason two-semester block schedule students had the smallest percentage of students who scored below the 19 score benchmark.

Discussion

Currently, very little information is available on how block scheduling relates to Algebra II and if school scheduling has an impact on ACT mathematics content scores. Most of the studies available were conducted using data from Algebra I classes or overall academics, not simply mathematics.

The first research question in this study was to determine if school scheduling had a significant effect on Algebra II end-of-course grades. It was determined that the students on a traditional schedule had the highest grades, followed by the students on a two-semester block. A study conducted in 2001, by Gruber and Onwuegbuzie, indicated that block scheduling did not have a positive effect on academic achievement among high school students. However, they also stated that the results of the study may be skewed because it was conducted during the first three years of block scheduling and because of the attendance level at one of the schools.

The results from the investigation of the second research question, indicated that there was no significant difference in ACT mean mathematics scores among the three teaching schedules. Less than one point difference occurred in the three mean scores. The results of this study are very similar to a study conducted in Illinois and Iowa. Pliska, Harmston, and Hackman (2001) reported that when examining the relationship among ACT Assessment scores and types of scheduling, the difference in scores was negligible.

Research question three was investigated to determine if a correlation exists between Algebra II end-of-course grades and ACT math content scores among each of the schedules. The results indicated that there was a moderate positive relationship among all three schedules. Additional studies to compare these results were not available. When examining these data, it appears a higher the grade in Algebra II will result in a higher ACT math content score.

Research question four examined the difference in teaching schedules and the percent of students who continued their mathematics education by taking Trigonometry. The results of the study indicate that the students on a two-semester block schedule, who had more time in the Algebra II classroom were more likely to take Trigonometry. Other studies comparing the percent of students who take Trigonometry were not available, however Rettig and Canady (1998) state that successfully completing Algebra I has been identified as a key factor for further academic accomplishment in mathematics. They stated that on an accelerated (4x4) block schedule, multiple concepts must be introduced each day. Even though some mathematically talented students will be successful at this pace, many students need more time to absorb material and practice concepts before moving ahead. If this is true for Algebra I, it is likely that it is also true for Algebra II. If students do not feel successful and confident with their skill level, they may not be likely to take an additional mathematics course which is not required for graduation.

Conclusion

Block scheduling has become an important part of education during the last decades of the Twentieth Century, and, as graduation requirements increase, has become a necessity for many school districts. It would be beneficial for educators to make subject-specific decisions concerning which classes are conducive to block scheduling, as measured by student learning. It is expected that, as more mathematics classes are required for high school graduation, the number of students enrolled will increase. According to the National Assessment of Educational Progress (NAEP), scores for 17-year-old students on the long-term trend assessment have shown no improvement in the past 25 years. The level of academics within the classroom has declined, as more students take newly required courses. Many schools encourage homogenous programs, which do not challenge stronger-achieving students and overwhelm lower-achieving students. Students in both groups are frustrated and undereducated (Steen, 2007). Lower-level mathematics students should and can learn – they just may not be able to learn at an accelerated rate. They must have the opportunity to graduate from high school and pursue the occupation of their choice. It is not in the best interest of education, as a whole, to have students unable to earn a high school diploma because of their failure to pass Algebra II on an accelerated block schedule. Results of this study indicate that, if enough time were allotted, students could be successful and many would continue their mathematics education beyond Algebra II.

Implications for Practice

National, state, and local government mandates the requirements for public school educators. It is the responsibility of the classroom teacher to see that mandates are followed. As standards change, curricula are expected to be both rigorous and relevant. Graduation requirements are increasing, and every child is expected to earn a high school diploma. Ultimate responsibly for educating students belongs to the classroom teacher. Mathematics educators have the responsibility to provide every advantage possible for students to be successful. In addition to teaching local and state standards, mathematics educators must prepare their students for new end-of-course exams and the mandated ACT Assessment in mathematics. In order to provide students with an exceptional curriculum, not merely the minimum, and to adequately prepare them for mandated standardized testing, time in the classroom continues to be a concern.

The school schedule with the highest mean ACT Assessment mathematics score, for students who had just completed Algebra II, was the two-semester block schedule; that schedule also produced, by far, the most students who enrolled in Trigonometry. One must ask if these results are only because of the schedule. The traditional year-long schedule had students with the second highest mean ACT Assessment mathematics score, in addition to the lowest percentage of students who continued their mathematics education by enrolling in Trigonometry. Then, the one-semester block schedule produced the lowest mean ACT Assessment mathematics score and a small (5%) increase over the traditional year-long schedule in the number of students who enrolled in Trigonometry.

The considerable difference in hours of classroom time among the traditional (165 hours per year), one-semester block (135 hours), and two-semester block (270 hours) implies that two-semester block schedule students should score highest on the ACT Assessment mathematics test, and that they are better prepared to continue to Trigonometry. Many students who completed Algebra II on a one-semester block schedule have indicated that it is too fast; the lack of retention of skill may be evident in the fact that, even though they were close in mean scores to the other two schedules, they were not willing to enroll in a course to go to the next level of mathematics.

With more time in the classroom, teachers would be able to teach to a greater depth of knowledge, and prepare students for the mandated ACT Assessment by helping them increase their test-taking skills. Students should be introduced to specific questioning styles that may help them develop a more comfortable attitude toward taking standardized tests (Carter, 2002). Another suggestion is to practice timed tests and activities within the classroom. For most students, a classroom mathematics test is not timed, so the students can relax and solve problems without feeling they need to watch the clock. The ACT Assessment, however, is timed. Many students panic, causing them to either run out of time or hurry through the test, and read questions improperly.

Block scheduling in schools across the country has been in effect long enough for many teachers who were educated before the practice, to retire. Kramer (1996) states that mathematics teachers are the most unlikely to change teaching methods to adapt to a teaching schedule. Additional training would be beneficial for most mathematics teachers, before implementation of a rigorous curriculum, with techniques for teaching the curriculum on a block schedule.

When block scheduling first became a popular choice for schools, it was determined that students in Algebra I did not get a good understanding of the basic concepts. Many schools that utilized an accelerated (4x4) block schedule made adjustments in their schedule for Algebra I, so these students would have mathematics every day, throughout the school year. Since Algebra II will be mandated for 2009, a modified block schedule would be ideal for teaching the course. After that, students may feel confident enough to continue their mathematics education in Trigonometry.

Implications for Research

Further research is needed in block scheduling, as it relates to high school mathematics. No research articles were found, which specifically addressed the problem of teaching Algebra II on an accelerated block schedule. There were several articles addressing Algebra I instruction, which were outdated. It is possible that, at the time when those articles were written, Algebra I was the only mathematics course mandated for all students for high school graduation. As high school graduation requirement rise, more mathematics classes will likely be required. In order for students to meet state requirements, block scheduling seems necessary for most school districts. Another study of school scheduling related to Algebra II should be completed within the next two years. That is when Tennessee has mandated Algebra II as a requirement for high school graduation, along with the implementation of Algebra II end-of-course tests, and mandatory administration of the ACT Assessment for all juniors in Tennessee high schools.

Since *No Child Left Behind* uses disaggregated data to determine AYP, it will be beneficial to study block scheduling in mathematics, as it relates to sub-populations, where end-of-course exams and ACT Assessment mathematics content scores could be evaluated. Students with learning disabilities related to mathematics and/or reading comprehension have difficulty in mastering the numerous objectives that must be taught in Algebra II, on a daily basis, when on a one-semester block schedule. Those students may receive a better mathematics education, when using an alternative schedule.

Tennessee has mandated the ACT Assessment test. As a result, further research could investigate the benefit of an ACT Preparatory class, which would be offered during the regular school-day as an elective credit in high schools. This could be of special importance to those students who complete Algebra II in December and need to perform well on an ACT Assessment in late April.

Finally, it would be useful to study the types of school scheduling, in relation to achievement on developmental mathematics courses at the college level. Are these students actually low achieving mathematics students or did they take their high school mathematics classes so quickly, and without depth, that they cannot retain the concepts?

Limitations

The limitation of this study is that students of all academic levels were not included in the research. As of school-year 2007-2008, Algebra II was not a required course for high school graduation. Those students earning a Technical Diploma are not required to complete a mathematics course at a higher level than Algebra I, as long as they have completed three mathematics courses since the beginning of the ninth grade. Therefore, low academic students are not included in the study. Among all three schedules, high-achieving students took Algebra II during the ninth or tenth grade and completed Trigonometry before taking the ACT Assessment test for the first time. Additionally, these high-achieving students could not be included in the study. In all three schools, several students chose to take the SAT, instead of the ACT Assessment, which excluded them from the study.

Recommendations

Questions still remain unanswered as to which schedule – the one-semester block, two-semester block, or traditional year-long schedule – is most conducive to student learning and retention of objectives in Algebra II. As a result of the findings in this study, and academic requirements mandated by the Tennessee Department of Education, the following recommendations are made:

1. Schools should consider adapting a two-semester block schedule for teaching Algebra II.
2. Schools should divide the Algebra II mathematics curriculum, implemented in the 2009-2010 school year, into two separate courses. Students should receive an elective mathematics credit for Algebra II-Part I and the required Algebra II series credit after completing Algebra II-Part II. Both parts of the course should be offered each semester, so a student can begin the Algebra II series during any semester.
3. Schools should offer an ACT Assessment mathematics preparation/review course. This elective credit would be a semester-long course that would be completed during the school day. For schools using an accelerated (4x4) block schedule, the course could be taught in conjunction with Reading/Language Arts, with each subject utilizing 45 minutes of the 90-minute block.
4. Beginning with the 2010- 2011 school year, schools should examine data resulting from the newly mandated Algebra II end-of-course exam and the mandated ACT Assessment mathematics test. It will be important to

understand the results from the total school population, as well as the sub-groups. From this data analysis, schools will be able to determine strengths and areas of need for their individual mathematics programs.

5. Schools should closely examine data for low-achieving students, as Algebra II is required to earn a high school diploma in Tennessee. Instructional decisions should be made as to the best way to educate these students.

REFERENCES

ACT, Inc. (2006). *Statewide administration of the ACT: A key component in improving student preparation for college and work*. Iowa City, IA.

ACT, Inc. (2008). *Homepage*. Retrieved July 30, 2008, from http://www.act.org

Association of American Universities. (2008). A National Defense Education Act for the 21st century, renewing our commitment to U.S. students, science, scholarship, and security. Retrieved August 9, 2008, from http://aau.edu

Belting, P. E., & Coffman, L. D. (1923). *The community and its high school.* New York: D. C. Heath and Company.

Bohan, C. H. (2003). Early vanguards of progressive education: The committee of ten, the committee of seven, and social education. *Journal of Curriculum and Supervision, 19*(1), 73-94.

Canady, R. L., & Rettig, M. D. (1995). *Block scheduling: A catalyst for change in high schools*. Library of Innovations. Princeton, NJ: Eye on Education.

Canady, R. L., & Rettig, M. D. (2000). Block scheduling: What have we learned? In W. G. Wraga & P. S. Hlebowitsh (Eds.), *Research review for school leaders* (355-382). Mahwah, NJ: Lawrence Erlbaum Publishers.

Carnegie Foundation for the Advancement of Teaching (2008). *Homepage*. Retrieved July 31, 2008, from http://www.carnegiefoundation.org

Carter, M. W. (2002). *Comparisons of traditional and block schedules on the ACT Mathematics test and Algebra I state examinations and on student perceptions.* Unpublished doctoral dissertation, University of Tennessee, Knoxville, 2002.

Cavanagh, S. (2007). Lessons drawn from Sputnik 50 years later. *Education Digest, 73*(4), 31-34.

Childers, G. L., & Ireland, R. W. (2005). Mixing block and traditional scheduling. *Education Digest*, *71*(3), 43-49.

City-Data.Com. (2008). *Tennessee bigger cities (over 6000): Detailed profile*. Retrieved July 31, 2008, from http://www.city-data.com

Connell, W. F. (1980). *A history of education in the twentieth century world.* New York: Teachers College Press, Columbia University.

Cremin, L. A. (1951). *The American common school: An historic conception.* New York: Bureau of Publication, Teachers College, Columbia University.

Culberson, E., Hughes, G., & Williams, J. (2006). *The effect of selected teaching strategies and programs in the area of mathematics implemented by eighth grade teachers at Science Hill High School*. Unpublished manuscript, Lincoln Memorial University, Harrogate, TN.

Danielson, C. (2002). *Enhancing student achievement: A framework for school improvement.* Alexandria, VA: Association for Supervision and Curriculum Development.

DiRocco, M. D. (1999). How an alternating-day schedule empowers teachers. *Educational Leadership, 56*(4), 82-85.

Dow, P. B. (1991). *Schoolhouse politics: Lessons from the Sputnik era.* Cambridge, MA: Harvard University Press.

Farrell, E. (2006). The national ACT score average rises as the test's popularity grows. *The Chronicle of Higher Education, 53*(2), 1 S 1.

Fuson, K., De La Cruz, Y., Smith, S., Lo Cicero, A., Hudson, K., Ron, P., & Steeby, R. (2000). Blending the best of the twentieth century to achieve a mathematics equity pedagogy in the twenty-first century. *Yearbook, National Council of Teachers of Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Gainey, D. D. (1993). *Education for the new century: Views from the principal's office.* Reston, VA: National Association of Secondary School Principals.

Gorman, B.W. (1971). *Secondary Education: the high school America needs.* New York: Random House.

Gruber, C. D., & Onwuegbuzie, A. J. (2001). Effects of block scheduling on academic achievement among high school students. *The High School Journal*, *84*(4), 32-42.

Hottenstein, D. S. (1998). An "unobjective" look at "objective" math research involving block scheduling. *National Association of Secondary School Principals Bulletin, 82*(597), 117-119.

Howard, E. (1997). Block Scheduling and Advanced Placement Mathematics: When Tradition and Reform Collide. *American Secondary Education, 26*(1), 13-16.

Jenkins, E., Queen, A., & Algozzine, B. (2002). To block or not to block: That's not the question. *The Journal of Educational Research*, *95*(4), 196-202.

Justiz, M. J. (1984). It's Time to Make Every Minute Count. *Phi Delta Kappan. 65*(7), 483-85.

Kramer, S. L. (1996). Connecting Research to Teaching: Block Scheduling and High School Mathematics Instruction. *The Mathematics Teacher, 89*(9), 758-768.

Lawrence, W. W., & McPherson, D. D. (2000). A comparative study of block scheduling and traditional scheduling on academic achievement. *Journal of Instructional Psychology, 27*(3), 178-182.

Lewis, C. W., Dugan, J. J., Winokur, M. A., & Cobb, R. B. (2005). The effects of block scheduling on high school academic achievement. *NASSP Bulletin, 89*, 72-87.

Lubienski, S. T. (2007). What We Can Do about Achievement Disparities. *Educational Leadership, 65*(3), 54-59.

Marshak, D. (1997). *Action research on block scheduling.* Larchment, NY: Eye on Education, Inc.

Marzano, R. J. (2003). *What Works in Schools.* Alexandria, VA: Association for Supervision and Curriculum Development.

Mayo, A. E. (2003). *A comprehensive study of the relationship of block scheduling to the teaching of mathematics*. Unpublished master's thesis, University of Wisconsin, Stout.

Mowen, G., & Mowen, C., (2004). To block-schedule or not? *Educational Digest, 69*(8), 50-53.

Noble, J., & Sawyer, R. (2002). *Predicting different levels of academic success in college using high school GPA and ACT composite score*. ACT research report series, 2002-4. Iowa City, IA: ACT.

Opalinski, G., Ellers, S., & Goodman, A. (2004). I know what you did last summer. *Principal Leadership, 4*(6), 32-37.

Pearson Education, Inc. (2008). *Student Administration System Information (SASI™).* Retrieved August 1, 2008, from http://www.pearsonschoolsystems.com/products/products2.htm

Pliska, A. M., Harmston, M. T., & Hackmann, D. G. (2001). The relationship between secondary school scheduling models and ACT assessment scores. *NASSP Bulletin, 85*, 42-55.

Rettig, M. D., & Canady, R. L. (1998). High failure rates in required mathematics courses: Can a modified block schedule be part of the cure? *NASSP Bulletin, 82*, 56-65.

Rudy, W. (1965). *Schools in an age of mass culture: An exploration of selected themes in the history of twentieth-century education.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

Salvaterra, M., Lare, D., Gnall, J., & Adams, D. (1999). Block scheduling: Students' perceptions of readiness for college math, science, and foreign language. *American Secondary Education, 27*(4), 13-21.

Schlechty, P. C., & Clinton, B. (1991). *Schools for the twenty-first century: Leadership imperatives for educational reform.* San Francisco: Jossey-Bass.

School Improvement Plan – Ann Whitney High School. (2007).

School Improvement Plan – Ernest High School. (2007).

School Improvement Plan – Willis High School. (2007).

Steen, L. A. (2007). FROM THE 2000s – Facing Facts: Achieving Balance in High School Mathematics. *The Mathematics Teacher, 100*, 86.

Stokes, L., & Wilson, J. (2000). A longitudinal study of teachers' perceptions of the effectiveness of block versus traditional scheduling. *NASSP Bulletin, 84*, 90-99.

Tennessee Department of Education. (2008A). *TDOE: Assessment, Evaluation, and Research Division*. Retrieved August 1, 2008, from http://state.tn.us/education/assessment/

Tennessee Department of Education. (2008B). *Tennessee Diploma Project: Standards Awareness Workshop*.

The National Assessment of Educational Progress. (2008). *NAEP – The NAEP Glossary of Terms*. Retrieved November 13, 2008, from http://nces.ed.gov/nationsreportcard/glossary.asp

U. S. Department of Education. (2008). *Glossary of Terms – No Child Left Behind.* Retrieved August 1, 2008, from http://www.ed.gov/nclb/index/az/glossary.html

United States. (1983). *A nation at risk: The imperative for educational reform: A report to the Nation and the Secretary of Education, United States Department of Education*. Washington, DC: National Commission on Excellence in Education.

United States. (1994). *Prisoners of time: report of the National Education Commission on Time and Learning*.

Wiener, R., & Hall, D. (2004). Adequate yearly progress: Is it working? *Principal, 83,* 12-15.

Willoughby, S. S. (2000). Numeracy and standards: The four faces of mathematics. In M. J. Burke & F. R. Curcio (Eds.), *Learning mathematics for a new century*. Reston, VA: National Council of Teachers of Mathematics.

APPENDIX A

Timeline

APPENDIX A: TIMELINE

Fall 2007	Write mini proposal for EDUC 715.
Spring 2008	Permission will be obtained for the study from the three school districts involved.
Summer 2008	Submit proposal and file paperwork to the IRB.
Fall 2008	Begin identifying students from Ann Whitney High School, Willis High School, and Ernest High School who graduated in 2008, completed Algebra II, and took the ACT within a semester of course completion.
	Gather and analyze data.
Spring 2009	Complete the writing of the dissertation and defense.

APPENDIX B

Budget

APPENDIX B: BUDGET

The budget for this study was minimal. All three high schools are within a twenty-minute drive of my home. The majority of the cost was spent on copies, visuals, and miscellaneous items.

APPENDIX C

Human Subjects Review Committee Forms – Ann Whitney High School

[redacted] SCHOOLS
APPROVAL FORM FOR RESEARCH PROPOSALS

REQUESTOR'S NAME Gayle H. Hughes

TITLE OF RESEARCH PROPOSAL A Study Examining Algebra II End-Of-Course Grades and Scores on the ACT in the Area of Mathematics Comparing High Schools with and without Block Scheduling

STEP 1: RESEARCH REVIEW OF CURRICULUM DIVISION

_____ We temporarily withhold approval of your proposal until you address the questions we have raised about it in the attached letter. (Include this form with resubmission of your proposal.)

_____ We conditionally approve your proposal and you may proceed with making contact with principal(s) of the appropriate school(s), but it is necessary for you to address the questions we have raised about your proposal in the attached letter.

X We approve your proposal. Proceed with obtaining approval of the principal(s) of the appropriate school(s).

[redacted] 4/4/08
Signature, Curriculum Division Reviewer — Date

STEP 2: PRINCIPAL'S EVALUATION

_____ I temporarily withhold approval of your proposed research being conducted in my school for reasons stated in the attached correspondence. (Include this form with the resubmission of your proposal.)

PRINCIPAL #1: _____ DATE: _____

PRINCIPAL #2: _____ DATE: _____

PRINCIPAL #3: _____ DATE: _____

✓ I approve your proposal. Please forward this form to the central office for approval of the director.

PRINCIPAL #1: [redacted] DATE: 4/7/08

PRINCIPAL #2: _____ DATE: _____

PRINCIPAL #3: _____ DATE: _____

STEP 3: DIRECTOR'S EVALUATION

_____ I withhold approval of your proposed research being conducted in our schools for the reasons stated in the attached correspondence. I am forwarding a copy of your proposal, a copy of this form, and a copy of our correspondence to the curriculum division reviewer. They will communicate with you further.

✓ I approve your proposal. Proceed with your research according to the conditions agreed upon in the preceding sections of this form and your research proposal.

[redacted] 4-7-08
Signature of Director — Date

NOTE: The signed copy of this form should be returned to the curriculum division for its records.
(Reference: [redacted] Board of Education policy 4.200)

Request for Research Approval

Gayle H. Hughes
Math teacher
Science Hill High School

Currently enrolled at Liberty University, Lynchburg, Virginia
Doctoral student

Dissertation Title: A Study Examining Algebra II End-Of-Course Grades and Scores on the ACT in the Area of Mathematics Comparing High Schools with and without Block Scheduling

I. Nature of the Research:

A. Purpose or objective: The purpose of this study is to determine the relationship between end-of-course grades in Algebra II and performance on the ACT in the area of mathematics, comparing a one semester block schedule at [redacted] High School, a two semester block schedule at [redacted] High School, and a traditional year-long schedule at [redacted] High School. For many students, mathematics is a complex subject to grasp, but it is essential for a solid education. Students in the state of Tennessee must complete Algebra II in order to graduate from high school with an academic diploma thus allowing them to pursue a four year college education. This study will attempt to determine if students are retaining the mathematics objectives to be adequately prepared to take the ACT test upon completion of Algebra II as determined by varying schedules.

B. Hypothesis (if appropriate): To examine the results of Algebra II grades and ACT mathematics content scores for three similar high schools, one on a one semester block schedule, one on a semester block schedule and the third on a traditional schedule, the following research questions will be investigated in this study:

1. Is there a relationship between end-of-course grades in Algebra II and ACT scores in mathematics for all students included in the study?
2. Among students who completed Algebra II on a one semester block schedule, is there a relationship between end-on-course grades in Algebra II and ACT score in mathematics?
3. Among students who completed Algebra II on a two semester block schedule, is there a relationship between end-of-course grades in Algebra II and ACT scores in mathematics?
4. Among students who completed Algebra II on a traditional schedule, is there a relationship between end-of-course grades in Algebra II and ACT scores in mathematics?
5. Is there a difference in the end-of-course grades in Algebra II between students who completed Algebra II on a one semester block schedule, a two semester block schedule and students who completed Algebra II on a traditional schedule?
6. Is there a difference in the ACT scores in mathematics between students who

completed Algebra II on a one semester block schedule, a two semester block schedule and students who completed Algebra II on a traditional schedule?

C. Contribution to the field of education or to the system in particular: Beginning 2009-2010, all students in the State of Tennessee will be required to complete Algebra II for high school graduation. This is a difficult course for many students and the Tennessee State Board of Education has just increased the objectives beginning school year 2008-2009. The results of this study may give insight to educators concerning scheduling and time spent teaching the course objectives. For some students, Algebra II is the course which may keep them from earning their diploma and it is important to teach the course on a schedule which will be conducive to maximum learning.

II. Research Method

A. Sample of Subjects: The participants for this study include students at [redacted] High School in [redacted] Tennessee, students at [redacted] High School in [redacted] Tennessee, and students at [redacted] High School in [redacted] Tennessee. The population for this analysis will be a random sample of students who completed Algebra II during school year 2006-2007 and took the ACT by December 2007. These three schools were chosen for this study for their similarities in population, relative size to the community, and the economic base of the community in which they are housed. In addition, they are located within a thirty mile radius and except for schedules are very similar in course offerings.

B. Measures: The student permanent record will be used for data collection. The researcher will use the last Algebra II end-of-course grade before for the ACT test was taken. The mathematics content area score will only be used from the ACT assessment. The researcher will have no contact with students and all data will be coded for confidentially purposes.

C. Research Design: This investigation will be an ex post facto study examining student achievement in Algebra II as determined by end-of-course grades and scores on the ACT in the mathematics content area. End-of-course grades will be used from school year 2006-2007 and ACT scores will be those earned within a semester of course completion. Additional data will be used to determine internal validity concerning the comparison of [redacted] High School, [redacted] High School, and [redacted] High School. The variables used for validity purposes are socioeconomic status, race, and gender. Data collection will occur Summer 2008-December 2008.

D. Procedure: The researcher will gather data from student records. All scores will be coded to ensure the safety and well being of the participant and at no time will the researcher be in contact with any participant.

The research study will begin with t-test for the independent variables of socioeconomic level, ethnicity, and gender to establish internal validity. It will be determined if statistically significant differences are present in the three school populations involved in the study. Pearson product-moment correlation coefficient (Pearson r) will be used to evaluate the relationship between end-of-course grades in Algebra II and ACT scores in mathematics for each high school. A scale of 1-4 will be used for grades and a scale of 1-36 will be used for ACT scores. The researcher will use a t-test for independent samples to evaluate the end-of-course grades in the three high schools and for ACT scores in the three high schools.

III. Results: The results of this study will be shared with the Principal at each high school. This request was made from the administrators when they were initially contacted to determine the feasibility of the study. As more and more objectives are added to the current curriculum and as test scores are expected to rise, the information from this study may prove beneficial to schools to help increase retention of curriculum. This study may also prove as a catalyst for good communication among high schools in upper east Tennessee.

IV. Interference with on-going education programs: This study will not interfere with any educational program in progress. The researcher will only need access to student records.

V. Adequacy of research design: The research design described in this proposal has been pre-approved by faculty at Liberty University. It is viewed as a doable study and one which can make a contribution to the field of education.

APPENDIX D

Human Subjects Review Committee Forms – Willis High School

From: [redacted]com]
Sent: Wednesday, April 09, 2008 10:29 AM
To: hughes, gayle
Subject: RE: Survey

Hi Gayle,

Your research project has been approved. I will send you an EXCEL file in the next few days (I am currently working with the file). It is a file that I am using for a different purpose. You can go through and pick out the rows that you need. The file has a row for each math course a student took , their grade in the course, the date of the course, their ACT scores on Composite and math, and the date of the ACT. I will remove the names, but you will have a number for each student. Do you think that will meet your needs for your research?

Are you planning to use the names of the school in your research or will it be reported as School A, School B, and School C?

We would like a copy of your dissertation when completed.

Have a great day!!

[redacted]
Director of Comprehensive School Improvement and Accountability
[redacted] Schools
[redacted].com

APPENDIX E

Human Subjects Review Committee Forms – Ernest High School

Reply Reply to All Forward

Study

[redacted].net]

Sent: Wednesday, September 03, 2008 4:30 PM

To: hughes, gayle

Mrs. Hughes,

It was good to hear from you. I hope your study is going well. You do have permission to use [redacted] High School in your study. We look forward to the results of your study and hope it will help us as we prepare our students for the future.

[redacted]

"It is easier to build strong children than to fix broken men."

--Frederick Douglass

[redacted]
Principal
[redacted] High School
[redacted]net

[redacted]

APPENDIX F

Human Subjects Review Committee Forms – Research Exemption Request

9/07 **RESEARCH EXEMPTION REQUEST** Ref. # ___________

Liberty University
Committee On The Use of Human Research Subjects

1. Project Title: Block Scheduling in High School Mathematics: Effect on Algebra II End-of-Course Grades and ACT Assessment Mathematics Scores

2. Please list all sources of funding. If no outside funding is used, state "unfunded": "unfunded"

3a. Principal Investigator(s) *[Must be a Liberty faculty member or investigator authorized by the Chair of the Institutional Review Board. If a student is the principal investigator, the student must have a faculty sponsor. Include contact information for both the student and the faculty sponsor as appropriate]*:

Gayle Hawkins Hughes -student
Science Hill High School, math teacher
Name and Title

423-929-0133, 423-426-1853
ghughes@liberty.edu
1506 Woodland Ave.
Johnson City, TN 37601

3b.Faculty Sponsor
Dr. Carol Mowen
Name and Title

School of Education
270-982-9231, cmowen@liberty.edu
Dept., Phone, E-mail address

Anticipated Duration of Study: September, 2008 (From) Spring, 2009 (To)

4. Briefly describe the purpose of the study.

The purpose of this study is to determine if there are statistical differences between end-of-course grades in Algebra II at three high schools in east Tennessee and statistical differences in mathematics content scores on the ACT Assessment at the same three schools. These three high schools utilize various schedules for teaching Algebra II. One uses a one semester block schedule, another uses a two semester block schedule, and the third uses a traditional year-long schedule. In addition, it will be determined if a relationship exist between end-of-course grades and mathematics scores on the ACT Assessment for each schedule. It is the hope of the researcher that, if through statistical analysis, one schedule appears to produce higher grades and ACT Assessment mathematics content scores, as well as, indicate retention of objectives through correlation, school administrators may choose to adopt the schedule most conducive to learning and retaining high school mathematics.

5. Provide a lay language description of the procedures of the study. Address ethical issues involved in the study (See the Avoiding Pitfalls in section of the IRB website for helpful suggestions) and how you will handle them. For example, consider issues such as how subject consent will be obtained (or explain why the study meets waiver guidelines for informed consent), how the data will be acquired, and how the data

will be stored confidentially once it is collected. Please attach pertinent supporting documents: all questionnaires, survey instruments, interview questions and/or data collection instruments, consent forms, and any research proposal submitted for funding.

I will be collecting student data from the 2008 graduating classes at three high schools in east Tennessee. Two of the high schools have end-of-course grades for all classes and ACT scores stored electronically in a student management program. For these two schools, I will be provided the data for each student by the district office research staff person. The data will be anonymous in that, the district office will have coded each student with a number and I will no access to names or any other personal information. The data provided will include the date and end-of-course grade obtained for all mathematics classes completed during high school, as well as, the date and score for the ACT Assessment mathematics content for each student. I will then determine which students meet the requirement for the study. The third school does not have data stored electronically, so I will pull permanent records to acquire necessary information. The student records are stored in the high school guidance office and will not be removed. The students will be numbered and data will be collected with a numeric identification. This will ensure confidentially and security. I have been granted permission for this study by the three school districts involved, under the condition that the real names of the schools are not used and all student data is coded. Permission from individual students is not required since the research is not considered sensitive. All data will be stored in an Excel file, under fictitiously named high schools, and each student will be coded by number.

6. Will subject's data be gathered anonymously? YES X NO ☐

The subject's data from two of the high schools will be anonymous, but the third which does not store student data electronically will be confidential.

7. Please describe the subjects you intend to recruit. For example, minors under age 18, adults 18 and over, students, etc. Also, please describe your recruitment procedures. How will you find participants for your study? How will you contact them? Please be explicit.:

The population for this study will be the 2008 graduating classes at three high schools in east Tennessee. The subjects will be those students who completed Algebra II and took the ACT Assessment test within a semester of course completion. The subjects for the study will be determined through examination of data that will include the Algebra II course completion date and the ACT Assessment date. I will have no personal contact with any students.

I have read the Human Subjects *"Research Exemption Request Guidelines"*.

Gayle H. Hughes　　　　Aug. 30, 2008

Principal Investigator Signature(s)　　　　Date

Dr. Carol Mowen　　　　Aug. 30, 2008

Faculty Sponsor (If applicable)　　　　Date

APPENDIX G

Human Subjects Review Committee Forms – IRB Approval 631.083108

Reply Reply to All Forward

IRB Approval 631.083108: Block Scheduling in High School Mathematics: Effect of A...

Milacci, Ellen Elizabeth

Sent: Tuesday, September 09, 2008 11:02 PM
To: Hughes, Gayle; Mowen, Carol; Garzon, Fernando L.
Cc: Milacci, Ellen Elizabeth
Attachments: Annual Review Form.doc (29 KB) [Open as Web Page]; Change in Protocol.doc (29 KB) [Open as Web Page]

Dear Gayle,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. Attached you'll find the forms for those cases.

Thank you for your cooperation with the IRB and we wish you well with your research project. We will be glad to send you a written memo from the Liberty IRB, as needed, upon request.

Sincerely,

Fernando Garzon, Psy.D.
IRB Chair, Liberty University
Center for Counseling and Family Studies Liberty University
1971 University Boulevard
Lynchburg, VA 24502-2269
(434) 592-4054
Fax: (434) 522-0477

APPENDIX H

Data

APPENDIX H: DATA

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
1	2	22	2		4	17	1		1	22	3
2	3	27	3		5	19	2		2	31	4
3	10	29	4		8	19	1		4	21	3
4	13	15	2		11	19	2		8	22	4
5	15	19	1		12	24	4		9	18	4
6	17	22	1		14	25	2		11	24	3.5
7	18	17	0		17	18	3		12	19	2.5
8	19	22	3		20	25	3		13	19	3
9	21	19	4		23	21	4		14	16	2.5
10	26	19	1		28	26	2		17	18	1
11	27	26	3		40	21	3		18	16	1.5
12	28	15	3		41	17	2		19	18	2.5
13	29	16	1		42	25	2		20	27	3
14	30	17	0		50	26	3		22	24	4
15	31	27	4		53	27	2		28	29	4
16	32	19	3		56	31	2		29	19	2
17	38	25	3		57	22	3		31	17	4
18	44	16	3		59	24	2		32	20	3
19	49	16	2		61	24	3		33	23	2.5

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
20	50	22	2		65	17	1		34	14	0.5
21	53	24	3		67	22	3		35	23	2.5
22	54	18	3		74	17	2		38	23	0.5
23	56	25	2		75	25	3		39	19	3.5
24	57	26	3		76	20	2		44	16	3
25	58	22	3		80	17	2		45	21	4
26	61	19	4		84	24	3		53	24	2.5
27	62	18	0		95	19	1		54	30	4
28	64	17	0		104	25	4		56	16	2
29	65	27	4		105	28	3		58	16	2
30	72	23	3		110	21	0		59	21	3
31	75	22	2		117	25	4		60	23	4
32	80	20	0		119	27	1		61	22	1.5
33	81	22	3		121	28	0		62	17	2
34	86	15	1		122	17	1		63	26	3.5
35	87	28	4		124	22	3		65	21	3
36	88	25	2		132	24	4		67	23	4
37	90	18	0		133	18	1		68	26	2.5
38	98	20	3		137	23	3		69	17	1.5
39	103	17	1		140	25	3		70	19	4

	School 1				School 2				School 3		
	ID	ACT Math Score	Algebra II Grade		ID	ACT Math Score	Algebra II Grade		ID	ACT Math Score	Algebra II Grade
40	107	20	4		143	27	3		73	21	4
41	110	15	1		148	16	3		74	22	3
42	111	16	0		150	20	3		76	20	2.5
43	112	17	0		151	17	2		78	27	3
44	113	17	1		161	27	3		79	16	1
45	115	19	2		162	28	2		80	16	2
46	116	22	2		164	21	3		81	17	2
47	117	17	2		165	20	3		82	26	3.5
48	119	17	0		166	19	2		84	17	3.5
49	120	20	2		168	19	2		85	27	4
50	121	16	2		171	17	3		89	21	3.5
51	123	22	3		172	19	2		93	25	4
52	124	26	3		174	24	2		97	25	4
53	125	19	2		175	20	2		98	25	4
54	126	29	4		176	24	2		100	32	4
55	128	19	1		177	21	2		102	20	0.5
56	134	17	1		178	25	0		103	15	1.5
57	136	21	3		179	16	0		105	24	2.5
58	139	21	1		181	17	2		107	24	2.5
59	140	17	3		185	24	2		109	20	4

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
60	141	23	4		187	19	3		110	21	3
61	143	22	2		188	17	2		112	22	3.5
62	144	19	2		193	21	2		113	20	3.5
63	148	18	3		194	21	2		114	25	3
64	150	15	1		197	18	2		115	25	3
65	151	19	2		198	22	2		116	16	2
66	153	19	2		199	23	2		122	22	3
67	155	23	1		202	24	2		128	24	4
68	156	21	4		203	17	2		129	18	3
69	157	25	4		204	18	2		130	18	2.5
70	159	27	4		210	24	3		131	21	2
71	94	22	4		214	22	4		132	16	2
72	467	24	0		217	23	1		134	28	4
73	471	20	3		218	28	4		135	26	4
74	473	17	0		219	25	4		136	20	2
75	161	18	3		223	18	2		138	16	2
76	164	21	2		227	17	2		139	17	1
77	172	17	3		229	25	2		186	25	4
78	177	23	4		233	17	0		141	18	2
79	178	21	2		234	21	4		187	19	3

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
80	181	25	2		238	17	3		145	17	2
81	183	30	3		241	26	4		148	27	4
82	188	18	1		242	19	3		149	26	1.5
83	194	19	3		244	25	2		150	15	3
84	195	19	0		247	16	1		152	22	2
85	198	17	0		254	24	2		157	27	4
86	199	19	2		257	22	0		160	25	4
87	204	21	2		258	19	4		161	25	4
88	205	23	4		259	27	3		162	16	3
89	207	21	4		260	23	2		163	20	3.5
90	209	21	1		264	18	3		164	24	2.5
91	211	19	2		265	17	2		167	19	2.5
92	212	19	2		266	22	2		169	15	2
93	213	27	3		270	26	2		170	22	0.5
94	216	20	2		274	25	3		172	22	3.5
95	221	18	0		281	23	2		173	26	4
96	222	21	3		282	26	3		174	18	4
97	227	17	1		283	17	2		176	22	1.5
98	231	18	0		284	17	2		179	25	2.5
99	233	25	3		285	18	2		180	21	3

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
100	236	19	3		286	26	4		184	14	0.5
101	237	22	3		287	17	2		185	22	1.5
102	238	21	4		288	24	3				
103	240	18	3		292	21	2				
104	244	24	3		293	17	2				
105	246	31	3		294	25	3				
106	250	23	0		303	29	3				
107	254	15	2		312	25	3				
108	256	16	2		313	16	2				
109	259	20	1		314	25	2				
110	263	16	2		315	23	2				
111	268	27	4		319	19	1				
112	271	20	1		322	17	1				
113	273	22	1		331	24	2				
114	275	22	4		333	23	2				
115	281	20	4								
116	287	23	3								
117	288	23	2								
118	289	27	4								
119	291	24	4								

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
120	294	23	3								
121	296	28	2								
122	299	24	3								
123	301	19	0								
124	305	24	4								
125	308	21	1								
126	311	24	0								
127	313	20	2								
128	315	23	4								
129	320	29	4								
130	322	14	1								
131	323	17	3								
132	326	18	2								
133	330	18	3								
134	335	27	4								
135	338	19	0								
136	339	23	3								
137	340	16	1								
138	342	24	3								
139	343	17	2								

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
140	344	24	0								
141	346	18	0								
142	347	22	0								
143	348	18	2								
144	356	20	0								
145	358	18	2								
146	359	14	2								
147	360	24	3								
148	361	21	3								
149	364	15	2								
150	370	18	2								
151	372	18	3								
152	373	23	2								
153	376	23	2								
154	377	16	0								
155	378	27	3								
156	379	21	2								
157	381	27	2								
158	382	18	2								
159	384	18	1								

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
160	388	23	3								
161	389	24	3								
162	393	23	2								
163	394	23	3								
164	395	21	1								
165	398	21	3								
166	399	26	3								
167	400	16	2								
168	401	30	3								
169	403	17	2								
170	405	18	2								
171	409	17	2								
172	413	21	2								
173	414	23	4								
174	416	17	2								
175	420	23	2								
176	421	21	2								
177	423	20	3								
178	426	24	2								
179	427	17	0								

	School 1				*School 2*				*School 3*		
	ID	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*		*ID*	*ACT Math Score*	*Algebra II Grade*
180	428	17	2								
181	429	19	2								
182	430	25	4								
183	433	24	2								
184	436	25	3								
185	440	23	0								
186	441	23	2								
187	443	25	3								
188	444	17	0								
189	447	22	2								
190	452	22	3								
191	457	18	3								
192	463	21	2								
193	464	14	0								