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Alternative Scheduling in the Middle School: Considering Circadian Rhythms.

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Alternative Scheduling in the Middle School with Regards to Circadian Rhythms

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by

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ABSTRACT

Alternative Scheduling in the Middle School: Considering Circadian Rhythms

by

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The passage of No Child Left Behind has increased the level of accountability for all educators. There are many factors that affect student achievement. One factor that may be overlooked is the schedule configuration of schools. Addressing student needs through scheduling options may assist school systems and students in performing at the level they are being held accountable.

The population for this study was students from a rural East Tennessee middle school with a population of approximately 700 students. The low socioeconomic students represent 68% of the school total enrollment while 18% of the students have an individual education plan (IEP). The gender of the school is nearly 50% male and female.

Looking at 2 research questions, an independent *t* test was used to determine if there was a significant difference in reading-language arts and mathematics Tennessee Comprehensive Assessment Program (TCAP) scores after implementing a rotating schedule. Subgroups used in this study were: students with an Individual Education Plan (IEP), low socioeconomic students, male and female students.

Results of this study were mixed. Students with an IEP showed an increase in both reading-language arts and mathematics. For all subgroups in reading, there was an increase in achievement although the results showed that there was not a significant relationship between the rotating schedule and student achievement. The only group to show gains in mathematics after implementation of the rotating was those students with an IEP. Each of the 3 remaining

subgroups actually showed a loss and there was a significant relationship between the rotating schedule and student achievement.

DEDICATION

This research is dedicated:

To my parents Roy and Peggy Carter, who instilled in me a good work ethic and taught me to be an honorable man. I appreciate you both for all of your support and love as well as giving me an opportunity to achieve a college education. You stood by me when I stumbled through life and picked me up when I fell. The milestones that I have achieved in life, even today, I credit to both of you. Even though you both are in heaven today, I think of you daily and still try to live up to your expectations. I love and miss both of you tremendously.

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CHAPTER 1

INTRODUCTION

The United States Congress reauthorized the Elementary and Secondary Education Act (ESEA) in 2001 and President Bush signed it into law on January 8, 2002. This act, known as the No Child Left Behind Act (NCLB), has added an accountability component on the part of educators. According to the NCLB Act, all students must be proficient in both mathematics and language arts by the school year 2013-2014 (United States Congress, 2002). Further, the NCLB Act mandates that schools unable to make adequate yearly progress (AYP) in the same area for the same subgroup for 2 years are deemed high priority. This act challenges districts to find means to meet the challenges and with limited resources.

The National Commission on Educational Excellence wrote *A Nation at Risk* in 1983. This report, commissioned to study the state of education in America, compared America's public education with that of other developed countries and found America lacking. It also made recommendations from the study. Among these recommendations, the commission recognized the need for educators to make better use of time. What followed was research that took a more in depth look at the student day and the structure within the schedule of schools.

The early 1990s was a time of continued studies in brain-based research as it is related to education as well as alternative school scheduling options. In a study addressing teacher perception of block scheduling by Brown (2001), it was noted "Other solutions were needed to create a more flexible time arrangement for secondary schools to meet the needs of both teachers and students. Alternative scheduling strategies became the means for addressing students' learning needs based on the multitude of cognitive research released at the time" (p. 2). Although research by Caine and Caine (1995), Gardner (1983), and Jacobs (1989) suggested

alternatives to the middle school scheduling norm, very few middle schools changed from the typical six-to-seven period day (Brown, 2001). This lack of change is due to the public's belief in the factory model structure for schools. Further, very little research has been conducted to verify the extent of the effectiveness of alternative scheduling.

Many scheduling configurations have been considered at all levels of K-12 public education. Some scheduling options include six to seven period schedules, block, modified block, departmental, and rotating flexible to name a few. When determining reforms school administrators may consider researched alternative scheduling options such as rotating flexible scheduling to improve student achievement. Differentiation in instruction may not only mean how a student learns best but what time of day a student learns best.

Instructional school leaders may consider those options that are in their control. One such option would be school scheduling. The school leader, specifically a middle school leader, may consider looking at brain research to understand how students at different developmental stages learn and the optimal conditions in which student achievement may occur. One such area of research is the times of day during which students best learn. Some educators maintain that the best time for learning occurs during the morning hours. This is in conflict with research that maintains that "the school day typically begins at an earlier hour as students get older, potentially exacerbating any problems created by a mismatch between circadian preferences and the timing of learning opportunities" (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998). This study further found that there is a shift of *morningness vs. eveningness* around the age of 12, or the beginning of middle school as measured by the Morningness Eveningness Questionnaire (MEQ). This being said, students may vary between morning to evening learners within a subgroup. It is essential that administrators be aware of this type of research when scheduling

students for academic success. There is a trend in some school systems to address this by differing school hours for elementary, middle, and high schools. This concept is not without its controversies that include funding, extracurricular activities, and older siblings being at home during times when their younger siblings depart for and arrive from school. Administrators are placed in a situation where they must be able to schedule within their own schools to address brain research and matching students' circadian preferences with learning opportunities.

The Tennessee Department of Education began applying its new curriculum standards in school year 2009-2010. It was theorized that these changes would drastically affect the percentage of students performing at or above the proficient level. According to Alapo (2010), "Only an estimated 26 percent of Tennessee eighth graders demonstrate mastery in math under new, more rigorous testing proficiency levels…" (p. 1). Due to higher standards leading to fewer students scoring at a proficient level coupled with public scrutiny and accountability placed on educators, school administrators may want to consider all options at their disposal.

Statement of the Problem

The purpose of this study was to determine the impact of a rotating schedule on the school's ability to make adequate yearly progress (AYP) as determined by the students' TCAP scores. Brain based research, as it relates to student achievement, received most of its attention as related to education in the 1990s. There have been very few studies that examine the effect of circadian rhythms on student achievement. It may be helpful for administrators to be aware of this type of research when scheduling students for academic success. This study may add to the body of knowledge about the impact of scheduling on student achievement.

Research Questions

This study was designed to address the following questions as measured by individual students' normal curve equivalence (NCE) TCAP scores.

1. Is there a significant difference in TCAP mathematics scores before and after implementation of a rotating schedule?
2. Is there a significant difference in TCAP reading-language arts scores before and after implementation of a rotating schedule?

Significance of the Study

No Child Left Behind required that all students be proficient in both language arts and mathematics by the year 2014. Administrators have struggled with how to accomplish this goal with limited resources and funding. Very little research has been performed to study middle school scheduling and the impact rotating schedules have on student achievement, even though a school's schedule should reflect a school's vision (Daniel, 2007). Differentiating the students' day to day schedule to adjust to learning profiles allows for learning styles above and beyond what the classroom teacher provides. Strickland (2005) wrote:

> Next, we seek to find out if the students for whom we are designing the journey vary in significant ways in terms of readiness, interests, and/or learning profile. If there are students who are more or less ready, more or less interested, more or less comfortable with a particular learning modality, we strive to identify these students' needs and then come up with one or more ways to approach content, process, and product assignments that respond to these differences and are equally respectful to the students for whom they are designed in terms of challenge and engagement. (p. 1)

This study examines the rotating schedule concept in a middle school setting and its impact on student achievement. Findings in this study may benefit middle school administrators and supervisors when debating different options for attaining the goals set forth by NCLB.

Limitations

This study is limited to the 2006-2009 Tennessee state TCAP data for John Doe Middle School. Adequate Yearly Progress was determined by the state's report card, issued each year. The student data management system was used to determine students enrolled during this period of time. Only those students present for all 3 years were used in this study. Low socioeconomic students were determined by free and reduced lunch applicants. Therefore, this study is limited to those students whose parents apply for this program.

Delimitations

This study is delimited to the state of Tennessee. The results may be generalized to other school systems with similar demographics and student enrollment. The readers may determine if this study is applicable to their own situation.

Definition of Terms

The following terms are defined to assist the reader to better understand this dissertation.

Adequate Yearly Progress or AYP- Under No Child Left Behind (NCLB), schools and school districts are measured on whether the students meet performance benchmarks in math, reading, and attendance for grades 3 through 8 and math, English, and graduation rate for high schools. Schools that do not meet the achievement standards for 2 years are deemed high priority (Tennessee Department of Education, 2010).

Alternate Day Classes- Sometimes referred to as an A/B schedule, this arrangement assigns classes on an every other day basis during the week. A student can take music on Mondays, Wednesdays, and Fridays (A schedule) and art on Tuesdays and Thursdays (B schedule) with the core academic classes meeting all 5 days. A career class and a study skills class can meet on alternate days, taught by two teachers or the same teacher, depending on staffing requirements (Daniel, 2007).

Brain based Learning- A concept that encourages educators to capitalize on the associations the brain must make to create synaptic connections and anchor learning through contextual experiences (Kaufman et al., 2008).

Block Scheduling- Scheduling patterns most often used by interdisciplinary teams, blocks of time usually consist of two or more combined periods. In its simplest form, blocks are all the same length of time (e.g., 100 minutes). For example, in the common "4 X 4" (four by four) scheduling arrangement, students take only four classes in the first half of the year and four different classes in the second half of the year (Hackman, 2010).

Circadian Rhythm- Roughly 24-hour cycle in the biochemical, physiological, or behavioral processes of living entities including plants, animals, fungi, and cyan bacteria (see bacterial circadian rhythms) The term "circadian" comes from the Latin *circa*, "around", and *diem* or *dies*, "day", meaning literally "approximately one day" (Diaz-Morales & Sorroche, 2008).

Differentiation- Differentiated instruction is a process to approach teaching and learning for students of differing abilities in the same class. The intent of differentiating instruction is to maximize each student's growth and individual success by meeting each student where he or she is and assisting in the learning processes (Hall, Strangman, & Meyer, 2003).

Dropped Schedule- Schedule configuration in which students are scheduled for more classes than class periods, with one class being dropped on any given day. This schedule provides allotted times for advisory programs, electives, assemblies, and other curricular offerings beyond core academic requirements (Hackman, 2010).

Morningness Eveningness- A term that refers to differences in adolescents' preference for carrying out activities at a particular time of day. These differences can be attributed to

rhythmic variation of behavioral and biological patterns (Diaz-Morales & Sorroche, 2008).

Multiple Intelligences- A theory that suggests that there are eight basic types of intelligence. The eight intelligences posited by Gardner are accepted in multiple intelligence theory are:

1. Spatial
2. Linguistic
3. Logical mathematical
4. Kinesthetic
5. Musical
6. Interpersonal
7. Intrapersonal
8. Naturalist (Gardner, 1999).

Neuroscience- A branch (as neurophysiology) of the life sciences that deals with the anatomy, physiology, biochemistry, or molecular biology of nerves and nervous tissue and especially with their relation to behavior and learning (Merriam-Webster,2009).

No Child Left Behind (NCLB) - A federal mandate that provides school choice, flexibility, and accountability in order to lessen the achievement gap so that no child will be left behind (United States Congress Public Law Print of 107-110, No Child Left Behind Act of 2001).

Response to Intervention- A strategy used by educators to identify students experiencing learning problems such as learning disabilities while giving support to students not performing well in the regular education classroom setting (Murawski & Hughes, 2009).

Rotating Schedule- Following a master schedule of all classes in sequence, classes are held at different times each day by rotating the classes one period later each day. This process enables students to have all subjects at various times of the day and can be implemented by teams or by an entire school (Daniel, 2007).

Tennessee Comprehensive Assessment Program (TCAP) - The Achievement Test is a timed, multiple choice assessment that measures skills in Reading, Language Arts, Mathematics, Science, and Social Studies (Tennessee Department of Education, 2010).

This research is broken in to five chapters. Chapter One contains the statement of problem and purpose. Chapter 2 is a review of related literature. Chapter 3 outlines the methodology. Chapter 4 reports the analysis of data. Chapter 5 offers conclusions and recommendations for practice and for further research.

CHAPTER 2

REVIEW OF LITERATURE

The review of literature was focused on student achievement and the role of the school schedule. Literature on brain based research, scheduling models, circadian rhythms, and later school start times proved beneficial in the role of scheduling students for success. The literature pertaining to this study fell into two overlapping categories: (1) research into brain based education and (2) research findings applying to scheduling students in a middle school setting.

Brain-Based Learning

The last decade of the 1900s has been characterized as the time when educators became interested in brain-based education; researchers conducted and developed theories about its application in the classroom (Bruer, 1999). Guild (1997) compared and contrasted established models, multiple intelligence, and learning styles with brain based education as to the role of both teacher and student. She reported on her observation of three different schools, each applying a different model. Teachers planned and worked to implement their assigned theory. Guild noted the striking similarities in the learning environment in each and stressed the fact that no particular one has the answers to how every student learns. Each student has unique needs and abilities that must be given consideration. She concluded each theory is distinctive. Each recognizes the uniqueness of individuals and the differing ways information is assimilated. She encouraged researchers to delve into learning theories to better understand the learner and the learning process.

Public interest in brain-based learning evolved in the last decade of the 1900s due to efforts of government as well educational and advocacy groups excited about reported advances in brain research. Bruer (1999) reported on the findings (or lack of findings) of a select few

researchers who have delved into brain-based education and he effectively analyzed the conclusions of each. Caine and Caine (1995) conducted research on the left hemisphere and right hemisphere of the brain and suggested the relevance of each to learning. Bruer refuted their findings "the results of research on split brains and hemispheric specialization are inconclusive. 'Both spheres are involved in all activities' . . . because the two hemispheres are connected in normal healthy brains; they concluded that the brain processes parts and wholes simultaneously" (p. 9). There has been a false assumption that language instruction and social learning skills are positively impacted by dual brain hemispheric concept; thus, educators should be aware that this research provides no evidence of its value. Bruer cited the work of David Sousa and his windows of opportunity. The window of opportunity idea has to do with the rapid acquisition of new knowledge, abilities, and skills most children acquire between the ages of 2 and 11. That which is mastered during this period serves as a basis to be built upon. Bruer concluded that educators and teachers must be aware that none of the above theories of learning have been established by neuroscience. "Brain based educators have uncritically embraced neuroscientific speculation. And where there is no scientific evidence, there is no scientific fact" (p.15). Traditional teaching practices and theories on learning have changed little. The rightness or wrongness of psychological research has not been evidenced by brain research. Traditional theories come from "cognitive and developmental psychology; from the behavioral, not the biological sciences; from our scientific understanding of the mind, not from our scientific understanding of the brain" (p. 3).

Caine and Caine (1995) provided details of a 3-year experiment in brain-based learning theory, as teachers adapted and used the concept in a Rio Linda, California, elementary school, grades K-6. The school, Dry Gap Elementary, had a large population of poor children. Because

of the low socioeconomic conditions, it was classified as a Title I school. Teachers and the curriculum were traditional; materials were basically textbooks, videos, and movies used occasionally. Teachers tended to teach as they had been taught; memorization and repetition being the most commonly used instructional techniques. Quantitative data were secured by testing. Traditional multiple choice and true-false tests were given to determine achievement. Standardized test scores had not been good. There was a high student turnover rate. Discipline issues were considered low by the teachers, enabling teachers to teach and students to learn. The schedule was inflexible, learning time guided by a master schedule. Caine and Caine found teachers, administrators, and the community bought into the brain-based learning theory as they began to understand the significance of the undertaking. Teachers began to comprehend that brain-based teaching and learning value overall student development academically and socioculturally. Subject matter should be presented logically and meaningfully, patterning content for enhanced learning. "Brain based learning also stresses the principle that the brain is a parallel processor--it performs many functions simultaneously . . . learning is complex and nonlinear" (p. 3). Meaningful instructional resources should be used and students given time to absorb and master the information.

Caine and Caine (1997) stated that the major objective of their program was to change the attitudes of teachers and staff, to encourage creativity in planning, and to instill in them the importance of using brain based teaching and learning for effective instruction. They reflected that the most important change was found in teacher responses:

> There's a feeling of excitement here . . . People are working with their colleagues, sharing kids in their classes through peer tutoring, cross-age work, and study buddies. We are not as isolated as we used to be. . . The process was often exhausting, but it was a rich place to be an educator. The biggest change I see is that, yes, this is a community of learners. It's moving from my class to our kids. (p. 6).

Once teachers understood the theories behind brain based research, they were more willing to change the way in which they had previously taught.

Researchers such as physicians and scientists presented findings relative to brain based learning. Weiss (2000) recounted relevant information. She discussed the intricacies of the brain compared to the Internet. "The brain's interconnections far exceed the Internet's by an astronomical number. The brain has approximately 100 billion neurons, and each neuron has one to 10,000 synaptic connections to other neurons" (p. 1). Weiss stated that normally the brain is functional and orderly and each individual brain is unique. Parts of the brain are continually sending output to other parts, all activity occurring within. Included was a discussion on topics that must be noted by those interested in brain-based learning; namely, attention, contexts and patterns, emotion, memory and recall, and motivation. Attention has to do with the process of selecting and storing information into short-term memory. Irrelevant information is discarded. The learning process is highly charged with emotion. Self-concept and basic human needs affect how information is processed and stored. Students tend to have attention spans lasting from 90-110 minutes followed by a drop in energy as well as attention to task. New facts are organized into patterns and interpreted by the brain in context with that which is already known. Recall is the ability to meaningfully activate what has been stored. High stress situations may interfere with higher order thinking and creativity. Caine (as cited in Weiss, 2000) stated that motivation is strongly affected by individual needs as well as cultural environment. Weiss also found that research in the last decade of the 20st century proved to be valuable as educators began to evaluate teaching and learning in relation to brain function. Some scientists found that educational research on learning was different than that done on educational theory.

Strict state standards, established curricula with set benchmarks, and student progress judged by adequate yearly progress (AYP) required by the No Child Left Behind Act (2002), may not effectively or efficiently promote learning. Today's teaching methods are not brain based. Neuroscientific research findings are ignored. Brain based teaching methods include challenging learning activities with students well nourished, socially adjusted, and subjected to regular physical exercise (Jenson, 2006).

Kaufman et al. (2008) conducted studies of brain research and revealed that the role of the brain in the learning process has not been given enough consideration. Increased interest in how the brain learns prompted more in-depth research studies in the 1990s. The authors cited the work of various researchers who looked into areas of learning, particularly early neurological research studies of Roberts (2002) and Sousa (2001) as their findings contributed to development of learning theories. They noted the works of LeDoux (1994) who found a "relationship between emotions, memory and the brain" and Eden, van Meter, Rumsey, Woods, and Ziffird (1996) who concluded that children learn to read by "using auditory and visual areas of their brain to create meaning" (p. 67). Again, Kaufman et al. are quoted, "The field of brain based learning encourages educators to capitalize on the associations the brain must make to create synaptic connection and anchor learning through contextual experience" (p. 2).

Caine and Caine (as cited by Kaufman et al., 2008) were able to see the relevance of applying brain based learning principles to educational practices. They began to work with educators developing curriculum and instruction to best accommodate the learner. They stressed the value of using these models of teaching and learning. Teachers should constantly be alert to new research findings and introduce as well as share their impressions with colleagues. Kaufman et al. cited the findings of Caine and Caine and others concluding from their research and

experience that "great teaching involves three fundamental elements: Relaxed alertness: Creating the optimal emotional climate for learning; Orchestrated immersion in complex experience: Creating optimal opportunities for learning; and Active processing of experience: Creating optimal ways to consolidate learning" (p. 4).

Willis (2007) was concerned with using brain-based teaching techniques to understand the nature of learning. She wrote that modern technology enables the investigator to actually watch the functions of the brain as it works. The electroencephalography (EEG) measures the brain's electrical activity. Specific polyethylene terephthalate (PET) scans measure metabolic activity and show glucose or oxygen use and blood flow. This technology shows patterns of information as they move through the "limbic system, and into memory storage regions" (p. 1). This information is vital to brain-based memory research because it shows methods and strategies that enhance or inhibit communication and processing. She spoke of dendrites as the connecting cells between neurons. These cells serve as communicators and increase as more information and skills are mastered. Learning leads to the growth of dendrites. Neurotrophins (proteins) stimulate the growth of dendrites. The growth of neurotrophins is greatest during childhood, and as more learning occurs, activity increases in regions where new learning occurs and new memory form. Willis stated that children between the ages of 6 and 12 experience the most growth in neurons and thus over a period of time if uninterrupted the brain becomes more efficient. She elaborated:

> Learning Promotes More Learning:
>
> Engaging in the process of learning actually increases one's capacity to learn. Each time a student participates in any endeavor, a certain number of neurons are activated. When the action is repeated, such as in a follow-up science lab experiment, rehearsing a song, or when the information is repeated in subsequent curriculum, these same neurons respond again. The more time one repeats an action (e.g., practice) or recalls the information, the more dendrites sprout to connect new memories to old, and the more efficient the brain becomes in its ability to retrieve that memory or repeat the action. . . .

> triggering the beginning of a sequence results in the remaining pieces falling into place. This repetition-based sequencing allows you to do many daily activities almost without having to think about them, such as touch-typing or driving a car. (p. 2)

Alternative Scheduling

Effective use of school time has been a concern of educators for generations. The Carnegie Unit, developed in the late 1800s, featured a structured scheduling format. Fifty-minute class periods were held daily. Subject matter areas were taught by teachers who were specialized in that field. The Carnegie unit was commonly used until late in the 20th century (Schroth, 2010).

In 1958 J. Lloyd Trump in *An Image of the Future* proposed flexible unstructured classes with large groups and independent study time. The format was used in some schools; however, the plan failed. High school students were not able manage the unstructured environment effectively. In the 1970s the Open School concept and fluid block scheduling were introduced. Neither concept was deemed satisfactory (Schroth, 2010).

The zero period schedule was introduced in the late 1980s. An extra class period was added at the beginning of the regular school day. Thus, students could elect to take more classes or leave early. This "flexible scheduling alternative . . . continues in popularity" (Scroth, 2010 p. 1).

In 1989 the Carnegie Council on Adolescent Development published *Turning Points*, which stressed the importance of planning middle school schedules to accommodate adolescents' developmental needs. Interdisciplinary team teaching was a popular approach. In order to implement these ideas, some middle schools changed to block scheduling and 90-minute class periods. High schools later adopted the schedule. Four or five teachers worked with "125 to 150 students, essentially creating a school within a school" (Schroth, 2010, p. 1). Schroth

commented, “Throughout the history of school scheduling the need for flexibility and the need for teachers to work cooperatively for the benefit of students are recurring themes” (p.1).

Daniel (2007) recognized the importance of flexibility in school scheduling. He emphasized the value of planning the school day for effectiveness. As such, the instructional day is not organized around fixed times for classes or other activities, day after day, yearly. Rather, the day is planned to meet the needs of teachers and students. Daniel theorized that flexible scheduling adapts to the creation of an environment that recognizes individuality. Teachers are free to objectively present subject matter in a way that meets the needs of students. Direct involvement enables teachers to better determine the amount of time needed for specific activities. “Flexible scheduling allows schools to optimize time, space, staff and facilities to add variety to their curriculum offerings and teaching strategies” (Canady & Rettig, 1995, p. 1). Daniel discussed four models of flexible scheduling that have reportedly been used in schools. He began with block scheduling, commenting that interdisciplinary teams are better able to use this model. The schedule is referred to as four-by-four block because the day is divided into four sections and students take only four subjects during the first half of the year. Four different subjects are taught in these blocks the second half of the year. Some variation may occur with academic subjects having longer blocks and electives assigned shorter time blocks. Middle schools may use a two-block arrangement; however, one block is scheduled in the morning and one in the afternoon. Of the Alternate Day Schedule, Daniel explained the class model that has often been referred to as an A B schedule. Classes are arranged on an every other day basis. Core academic classes meet every day with subjects such as art, music, chorus, etc. able to meet on alternate days. In some middle schools this schedule refers to students taking two core academic classes

(i.e., language arts, social studies) on the alternate day. With the Rotating Schedule model, as the title implies, classes rotate daily. A daily schedule is set with all classes in sequence. Classes rotate one period later each day until all have changed once. This process is then repeated. Each student should have an opportune time for learning, if one time of day is better than another. The Dropped Schedule model permits students to carry extra subjects, dropping one on any day to attend assemblies, electives, meetings, etc. More classes are scheduled than time allotted. The student may elect to alter his or her schedule to attend an activity. Daniel noted that there has been little research on flexible scheduling in middle schools. However, he cited the findings of one study comparing scores on standardized achievement tests in science and in language arts with students enrolled in one of the other three scheduling models. The flexible schedule model proved beneficial for students. Comparisons showed greater achievement in science and language arts, with lower achieving students showing impressive gains.

Representatives of The National Middle School Association (1999) conducted research on the use of flexible scheduling in middle schools in the 1990s. According to the findings, relatively few schools were using anything other than standard seven instructional periods each day. Selected exemplary middle schools reported use of some form of flexible scheduling. Approximately three fourths indicated flexible scheduling was being used; however, it was not fully developed. Other middle schools reported little or no use of flexible scheduling.

Hackman and Valentine (1998) discussed thought processes involved in developing a workable middle school schedule. The importance of effective planning was emphasized. Matters to be considered of relevance were attention to curriculum, materials to support the curriculum, and a time and place for each scheduled activity. It was noted that utmost consideration must be given the administration, students, teachers, staff, and parents. The authors

view scheduling as a tool to facilitate the school's goals and purposes with curriculum, instruction, student grouping, and staffing given appropriate consideration. Hackman and Valentine (1998) stressed that schedules be planned with consideration given to core academic subjects, insuring mastery of basic skills as well as planning time for elective subjects such as computer, art, music, and band. "Additionally, the schedule should permit the use of such varied instructional strategies as interdisciplinary instruction, cooperative learning, infusion of technology, use of experiments, authentic assessments, active learning, independent study and small or large group activities" (p. 4). The authors noted that flexibility is positive because it allows teachers time to collaborate with others, express individual creativity, and use their unique strengths to the advantage of students and staff. Further, teachers should be empowered to objectively evaluate curriculum priorities and capitalize on learning opportunities that present themselves. When planning a flexible schedule, systems are advised to look into the programs of other schools. However, Hackman and Valentine suggested that the schools' flexible schedule will probably be most successful if it is designed by its own teachers and staff with the student population and their needs in mind.

No Child Left Behind, enacted in 2002, required the nation's school systems to adopt procedures designed to raise achievement levels. According to the law, schools are to be held to specific standards and accountable for the success or failure to meet those standards. Student progress is noted by the compilation of data showing progress or lack of it. Adequate Yearly Progress (AYP) becomes a measuring tool to show how well a student, and consequently a school, is achieving its goals. Elmore (2000) expressed concern that proposed changes in education emanate from sources far from the classroom. Suggested improvements come from "national panels, formed by professional organizations or created by foundations, from the

media, and from politicians, who are advised by representatives of business and industry. Occasionally, teachers are invited to the conversation" (p. 3).

Elmore (2010) stressed that earlier recommendations such as those in the Carnegie Council on Adolescent Development Task Force's report *Turning Points* (1989) had been misunderstood. Many had felt that teachers interpreted recommendations made by this missive to mean that social and personal development was to be emphasized more than academic achievement. He commented that teachers and school officials had not misinterpreted the recommendations of *Turning Points*. Rather, he stated that *Turning Points* did stress academics but not to the exclusion of social and personal issues. Elmore theorized that the middle school curriculum should embrace an appropriate academic curriculum, wherein students are challenged to analyze material critically. Excellent middle schools are structured to foster individual responsibility and social equality.

Brown (2001) found that most middle schools had not changed from the traditional schedule of 40 to 45 minute classes. He identified some middle schools that were using a 4x4 flexible schedule. He wanted to assess the value of this type of schedule as to its effect on teachers' instructional behavior and students' learning needs and was interested in learning how teachers perceived its effectiveness. Two middle schools in the middle Atlantic region of the United States were selected to gather information and data. One of the schools was in a rural area, with a total population 450 students containing seventh and eighth grades. The other school was suburban with approximately 1,200 students in the sixth, seventh, and eighth grades. The researcher asked for teachers to be interviewed and respond to 25 questions to determine their perception of how the 4x4 block had impacted instructional practices and curricular decisions and how students' learning had been affected. Ten teachers volunteered to be

interviewed, six from the suburban school and four from the rural school. The following summation reflects teacher perceptions of the 4X4 block schedule.

Brown (2001) concluded that most teachers' perception of the flexible schedule was positive. Nine of 10 teachers reported changing planned instructional procedures and techniques. The extended time period allowed for more creative learning experiences, in depth study of subject matter, and other topics. A wider variety of instructional strategies could be used. 9 of the 10 teachers reported positive effects on student learning. Varying instructional strategies allowed teachers to better address specific learning issues and to serve those with different learning styles. One half of the teachers reported changes in the way they assessed student progress. They reportedly used more "essay and application type questions; different kinds [of assessment]: visual, experiments, and more realistic evaluation with equipment to test laboratory skills" (p. 9). These responses were considered to be favorable. However, the remaining five teachers stated that there was no reason for changing the way they had previously conducted students' assessment. Brown (2001) also concluded that flexible schedules were advantageous for middle school students. Knowledge and understanding of the developmental level of students was a primary concern.

Hackman (2010) noted content of the article is relevant today in that more schools are changing from traditional scheduling to flexible styles. Changing the school schedule involves strategic planning. Hackman presented guidelines to direct the initiation of an alternative schedule. He emphasized that every stakeholder's ideas must be given consideration as well as the responsibility of each clearly understood. Valid reasons for restructuring must be incorporated into the process. Guidelines should include collaboration among those who must understand and implement the transition process. Parents, community leaders, and those who

plan the school budget should be invited to attend planning sessions in order to develop an understanding of scheduling alternatives, and, ultimately, on the evaluation of the schedule's effectiveness. Effectiveness will be reflected in outcomes. "The common consideration: What is best for the students" (p. 3).

Circadian Rhythms

According to Callan (1998) circadian rhythms refer to the mental and physiological changes that take place every 24 hours in most all organisms. Individuals differ within a species in their preferences of which time they perform at their best. The Mayo Clinic (1995) has identified more than 100 circadian rhythms that recur daily. These rhythms range on a scale from one extreme to another. Morningness or morning people are those who perform at their best during the morning hours while eveningness or evening people are those who perform best in the evening hours (Callan, 1998). A person's morningness and eveningness, or ME, may be measured by his or her temperature. Morning people tend to reach their peak temperature in the morning hours, while their evening counterparts reach theirs in the evening (Kleitman, 1963).

Parents, teachers, and educational researchers have theorized that sufficient sleep is needed if students are to do well academically. They recognized that students may not function well the day after an activity had caused bedtime to be delayed. Researchers have conducted studies to find the connection between sleep and school performance. In a clinical review on sleep, Wolfson and Carskdon (2003) cited the work of researchers Terman and Hocking who posed the question, "What is the optimal amount of sleep for physical and mental efficiency?" (pp. 138-147). Investigators have assumed there are valid ways to study sleep and adequate human performance. Conclusions drawn may be useful in further research studies; however, most have been based on student experience rather than on experimentation. Meehl (1954)

reported in *Clinical Versus Statistical Prediction* (1954) "experiences are inherently unreliable measures of human behavior . . . clinical observations are hunches and not facts" (Wolfson & Carskadon, p. 1). Meehl stressed the need for repetition of studies before validating data (p.2).

Wolfson and Carskadon (2003) emphasized the difficulty of measuring school performance in relation to poor sleep habits. The relationship may be subjectively assumed and data considered relevant based on "inadequate appraisal of the phenomenon" (p. 2). Self-reporting of sleep habits and grades may affect the reliability of data. Wolfson and Carskadon reported on studies designed to secure, assess, and compile data.

Wolfson and Carskadon (2003) analyzed an abstract wherein 150 high school students ages 15 to 18 were surveyed. The study was conducted by Link and Ancoli-Israel (1995). Procedure involved students reporting their self wake schedules and grade averages. Subsequent findings revealed students with a higher grade point average (3.5) were more alert during school, slept better at night and got up later on school days, averaging 7.4 hours of sleep. Students with lower grades were sleepy during the day, often needed daytime naps, and averaged 7 hours sleep at night (p. 496).

Wolfson and Carskadon (2003) emphasized the difficulty of assessing data objectively based on subjective appraisal. Self-reporting of sleep habits and grades may not be totally reliable. Wolfson and Carskadon reported on studies designed to secure, assess, and compile data. They analyzed a study conducted by Link and Ancoli-Israel. One hundred fifty high school students ages 15 to 18 were surveyed. Results were presented in abstract form. Procedure involved students reporting self wake schedules and grade averages. Further, Wolfson and Carskadon cited a survey by Kahn and colleagues. Sleep wake patterns were examined in relation to academic performance. Subjects of the study were "972 older children and

preadolescents in Belgium. To secure data, parents completed questionnaires reporting sleep patterns, the educational level of parents, "children's daytime patterns and school achievement" (p. 496). In a later abstract Blum et al. (1990) summarized the data, concluding "analysis showed that the best predictors of school failure were the children's fatigue (operationalized as difficulty to arouse in the morning and need for at least one daytime nap) as well as parents' educational level" (p. 496).

Wolfson and Carskadon (2003) cited a study by Hofman and Steenhof who questioned some 600 high school students in Holland to find if there is connection between sleep patterns and school performance. Students were surveyed to secure data. Analysis of data suggested that better sleep quality did have an effect on grades and better school performance. Drugs, alcohol, caffeine, and nicotine adversely affected grades (p. 496). Wolfson and Carskadon further cited findings of Cortesi, Giannotti, Mezzalira, Bruni, and Ottaviano that have relevance in this context. Cortesi et al. concluded that socioeconomic status did not affect student's sleep patterns; however, students' from broken or not intact families "had more irregular sleep patterns" (p. 707). The Wolfson and Carskadon cited Dornbusch who found "Students with pure authoritatively oriented parents reported the best grades and inconsistent parenting styles were correlated with the lowest grades" (p. 501).

Environmental influences were found to be significant predictors of student success. Those with different ethnic backgrounds and lower socioeconomic status tend to function better in small community schools. They make better grades and attend more regularly. "Community SES predicted grades for both African American and Non-Hispanic white students as well" (Wolfson & Carskadon, p. 501). Highly skilled teachers, compensated with higher salaries, working in well equipped facilities have a positive effect on student achievement.

Wolfson and Carskadon (2003) commended researchers who were able to show a relationship between adolescents sleep-wake patterns and school performance. However, they recommended that further large scale studies be conducted with clearly defined methods for validating grades. Student self reporting of grades tended to be fairly accurate except for some who do not achieve well. They tended to report better grades than they had made. Wolfson and Carskadon suggested, "Explicit operational definitions of school performance need to be provided" (p. 504). Studies should "gather longitudinal data across several weeks, months, as well as years of school performance, behavioral, and sleep data" (p. 503).

Diaz-Morales and Sorroche (2008) investigated morningness eveningness as related to differences in adolescents' preference for activities at a particular time of day. They reported that these differences could be attributed to circadian rhythmic variations. Circadian rhythms (i.e., body temperature, cortisol, or melatonin) reach maximum levels 1 to 3 hours earlier for some people; thus, they may perform more efficiently at these times. Adolescents involved in this study were ages 12 through 16. The writers cited research findings that suggest there is a gradual change from morningness to eveningness as individuals mature. This change toward eveningness was attributed to family and school demands as well as to pubertal development.

Diaz-Morales and Sorroche (2008) clearly stated that this study did not examine scholastic achievement. They suggested that the findings were relevant to the scheduling of classes. Students do better when they are performing at their preferred time of day, the time that is best suited to their individual circadian rhythms. They are better able to concentrate and less likely to become distracted.

Klein (2004) recognized the connection between biological rhythms, scholastic performance, and school schedules. Research studies confirm the relation between the time of

day tasks are performed and learning achieved. Klein noted that educators have reported a difference in students' reading skills level of achievement when classes were held at different times of day. He attributed this phenomenon to the circadian cycle, biochemical and physiological activity resulting in changes in human function. Klein called for additional research to validate conclusions regarding changes in achievement and the time of day as well as the subject matter being taught. He reported the findings of a study involving 850 middle school students. Academic subjects requiring intensive reading such as literature and history were of primary concern. The research was to identify hours when students felt more capable of mastering the subject matter. During the study there was no lunch break, but the pupils were given 5 to 10 minute recesses between lessons, one 20 minute snack, and an activity break at 10:00. Classes began at 08:00 a.m. and ended 14:30 p. m.

The findings of the Klein (2004) study supported the hypothesis that student learning varies at different times of day. A chart showing scholastic achievement revealed that the first period of the day (8-9) was characterized by low performance (registered at approximately 78 grade points). The 9 to 10 hour showed a slight increase; however, the 10 to 11 hour showed a decrease, falling to approximately 73. The 11 to 12 hour registered the greatest increase in academic achievement (80 points) followed by a decrease of 10 points in the next hour. During the last hour of the day, student achievement showed an increase to almost that of the 11 to 12 hour.

Klein (2004) suggested that the decline in achievement during the 12 to 13 hour was due to circadian rhythms not because of eating. Students had not had been served lunch. He remarked that the specific biological processes responsible for this decline should be identified. Differentiation in achievement indicated that competent students were able to achieve well

during the entire day. Their ability to adapt unique individual attributes allowed them to overcome difficult situations. Less capable students did not have the personal tools to sustain interest and concentration an entire day; thus, scholastic achievement declined. Weaker students performed better earlier in the day. Those responsible for making the school schedule "must take in account the subjects in which classes perform best . . . which study hours are most effective among pupils with different academic potentials . . . to schedule for the hours during which attention in typically low and, conversely, the times that are conducive to high attention" (p. 9).

There is a continuous shift from morningness to eveningness as children move from childhood to adolescent (Russo, Bruni, Lucidi, Ferri, & Violani, 2007). Russo et al. cited a study conducted in 2003 by Gau and Soong that found children ages 9 to 11 had significantly higher morning scores than those in the 11-14 age groups. Very little data have been collected to determine primary school age students' sleep habits and sleep problems as they relate to sleep-wake and circadian preference. Russo et al. conducted a study designed to investigate sleep patterns, sleep related problems along with circadian preference. The study focused on children from ages 8 to 14. The results of the study found that bed time for the majority of children (59.2%) of this study was determined by the child. This percentage gradually rose as the age of the child increased. As related to morningness and eveningness, the evening type children showed sleep patterns that were more irregular than the morning type. According to the results of the study:

> …results indicate that the delay of sleep-wake cycle starts during preadolescence and our trend analysis shows that bedtimes and rise times delay linearly with age during weekends when: (a) there is a progressive decrease of parental control over bedtimes; and (b) rise times are not constrained by the school schedule. (p. 167)

Changes in sleep patterns are generally attributed to greater social opportunities, higher levels of academic responsibilities, and access to more extracurricular activities.

The morningness eveningness questionnaire was used to determine circadian preferences. This scale ranged from 43 (extreme morning) to10 (extreme evening). The results revealed the mean score for the sample was 28.2 with 95% confidence intervals. There was no significant difference reported by gender in circadian preference.

Adolescents' circadian preference tends toward eveningness. An Australian study was conducted to assess adolescent holiday and school term sleep patterns (Warner, Murray, & Meyer, 2008). A time 1 survey (holiday) and a survey of time 2 (during school term) was recorded. "A self report survey adapted from the School Sleep Habits Survey (Wolfson & Carskadon, 1998) was designed for the . . . study" (p. 597). Three hundred eighty senior high school students from three metropolitan schools participated in Time 1, 310 students in Time 2. Students were in grades 11 and 12, 15 to 18 years old. Time 1 students were 64% female and 36% male, 63% female and 37% male in Time 2. Students were asked to keep a sleep log to "retrospectively record their bedtimes (BT) and wake times (WT) over the previous two weeks, and the time they estimated that it took them to fall asleep" (p. 597).

Adolescent sleep times and patterns have been identified with mood swings, poor performance in school, more accidents, and substance abuse. Others suggested that the quality of sleep may result in poor daytime functioning. Warner et al. (2008) noted that no comparisons had to date been examined between holiday and school term sleep patterns in relation to these factors. This study was designed to do so. It was the:

> hypotheses that at school time, students would obtain less sleep . . . accrue significant sleep debts and exhibit more variability in sleep patterns during the week. . . . individual circadian preference would impact negatively on the outcome variables of mood, daytime functioning, and grades through its influence on sleep variables at school time. (p. 297)

Warner et al. (2008) concluded from models compiled there was less variability in students' holiday sleep times on weekdays and the weekend. Sleep time was recorded at 9 hours and 12 minutes. School time students reported sleep debts because of early school start time an earlier wake time was required. Structural models suggested there was a "link between circadian preference, sleep factors, mood, daytime functioning, and grades distinct from any influence of sleep factors" (p. 605). Circadian preference did have an indirect outcome on sleep variables during school time. Students reported difficulty in getting to sleep thus accruing sleep debt. Poor sleep quality often resulted in poor daytime functioning, lower grades, lowered mood, daytime sleepiness, and difficulty concentrating. Later school start times might prove advantageous for all students, particularly those whose circadian preference is evening oriented.

This study was limited to a small group; however, a repetition with larger groups is needed to validate findings.

Later School Start Times

Research conducted in the last 2 decades related to education and school scheduling has prompted many school districts to reevaluate start times for adolescent age students (Wahlstrom, 2002). Early 1990 brain research coupled with sleep research and circadian rhythm studies prompted researchers such as Wahlstrom to conduct longitudinal studies. Based on studies which found teenagers' sleep patterns are significantly different from both adults and preadolescents, the Minneapolis Public School District shifted the start time for schools in 1997. This was the subject of Wahlstrom's longitudinal quantitative study.

Several significant findings came from the Wahlstrom study. The biggest beneficiaries of this change were students (Wahlstrom, 2002). Attendance rates for students, who were continuously enrolled rose during the 3-year time of the study. This was especially important for

administrators who were concerned about their at-risk students. There was a slight increase in teacher given grades; however, the increase was not considered significant. Another important result of the study was the integration of the medical community and education. This gave credibility to the biological differences of students as well as brought to the forefront previous studies on circadian cycles conducted in Brazil, Italy, and Israel. "Good policy decisions are made with good data. The data from the Minneapolis study, combined with current knowledge of physiology of adolescent maturation and brain development, give some clear markers to districts concerned with the overall well being of their teenage students" (Wahlstrom, p. 20). Bronson (2007) reported in *New York Magazine* that it is believed that lost sleep has an exponential impact on children. This is because a child's brain is a work in progress, and much of the development of the brain takes place while one is asleep.

Sleep patterns continuously shift throughout one's life as one moves from childhood through adolescence to adulthood (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998). Social responsibilities such as extracurricular activities and enhanced peer pressure coupled with more rigorous academic challenges force many high school students to bed at later times. In self-reports adolescents stay up later at night than preteens and do not have an early spontaneous wakefulness. The change in responsibilities and academics may not be the sole reason for teenage late sleep patterns. Circadian rhythm of individuals also changes as one evolves from childhood to adolescence. Therefore, many teenagers' biological makeup may determine their sleep patterns. "Evidence in support of this second hypothesis comes from correlation of self reports of pubertal development and circadian phase preference, and –more strongly -from a correlation of physical measurements of puberty with the offset phase of melatonin secretion measured in a constant routine" (p. 872). This information is in direct opposition to many

school systems' schedule that starts high schools earlier than elementary and middle schools. Circadian rhythm is the mechanism that controls the sleep patterns of individuals. This mechanism is thought to dictate rapid eye movement (REM) sleep as well as the timing of sleep and alertness.

Carskadon et al. (1998) conducted a study to examine the sleep patterns of adolescents and early school start times. This study evaluated twenty-five 9^{th} and 10^{th} grade students through both self-reporting as well as saliva samples taken during the evening hours to determine dim light salivary melatonin onset phase (DLSMO). The self-reporting phase of the study was conducted at the individual student's home under normal conditions during the week. The DLSMO portion of the study was conducted in a laboratory setting and was based on school night sleep patterns.

The results of this study indicated that students woke earlier on school days; however, they did not change the time in which they fell asleep. This results in less time for sleep in adolescents who require 9 hours of sleep to perform at their optimal alertness (Carskadon et al. 1998). Further, the study showed a delay of the onset of melatonin secretion in early morning start times. This was not the predicted outcome that presumes that earlier start times extend early morning lighting. The study concluded that early school start times in adolescents led to sleep deprivation and limits their ability to adjust to early school start times.

High school and middle school start times are determined by a variety of reasons. These include but are not limited to economic background of the students, number of bus tiers, and school size (Wolfson & Carskadon, 2005). The writers investigated the earlier start times on student performance. The study indicated those students who were required to begin school at earlier times (7:20) than students with a later school start time (8:25) fell asleep later and showed

atypical sleep patterns. "These findings were attributed to the combination of too little sleep occurring at a time mismatched to internal circadian rhythms" (p. 48). The results indicated in the 15-year period of the study showed that little change had taken place in middle and high school start times. The majority of schools reported that administrators had neither changed nor expressed any interest in changing the schools' start times.

Studies have been conducted in the last 15 years concerning the relationship of adolescent sleep patterns and school start time. Researchers repeatedly find that the sleep patterns for adolescent children are different from those of both preadolescents and adults (Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005). In a survey conducted with 12 to 15 year old students, early school start times coupled with delayed circadian sleep phase has been linked to rebelliousness, inattentive behaviors, and moodiness. The report also stated there was considerable sleep debt during the week due to early school start times. Students' sleep schedules were markedly different during the weekday when compared to weekends. This indicates that students are making up for lost sleep debt experienced throughout the week.

Hansen et al. (2005) also pointed out that there is a strong relationship between a student's circadian clock and light. Their study examined the impact of sleep loss on neurocognitive performance and mood, examined the relationship between weekday sleep patterns and weekend sleep patterns, and tested whether early morning light treatments could improve academic performance as well as mood and health. The study consisted of 60 incoming high school advanced performing students. The students were to keep sleep diaries beginning in August through the first 2 weeks of September and the months of November and February. A white light treatment in early morning classes was administered to 19 of the students. These treatments were given during the last 2 weeks of November as well as the last 2weeks of

February. The students were tested by computer for neuropsychological performance while pencil paper tests were used to measure mood and vigor.

There were several conclusions reached from the Hansen et al. (2005) study. The study supported previous studies indicating that adolescents' intrinsic sleep cycle needs are not being met by many school districts' early start times. Further, it was determined in this study that students lost as much as 120 minutes during the week and the weekend sleep cycle was considerably longer to compensate for this sleep debt. Although the light treatment did not offset the lack of sleep during the night, as evidenced by the test results. . . "light administration might still be the most straightforward intervention to affect adolescent sleep cycles" (p. 6). Further recommendations of this study were a change in school start times as well as educating students, parents and, teachers in the importance of adolescent sleep cycles.

Summary

Brain-based educational theory is predicated on neuroscience. The brain performs many functions at the same time. Interconnections send information to other areas continually. Brain based curriculum and classroom strategies stress the importance of student academic achievement and social development as well as emotional and physical health. The circadian rhythm continuum begins with morningness and tends to drastically change to eveningness with the onset of puberty. Studies show a link between circadian preference and academic performance. Traditionally, schedules have not recognized circadian preferences.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The purpose of this study is to examine the effects of a rotating schedule on academic progress in a middle school setting. Included in Chapter 3 are sections on research design, population of the study, data collection procedures, and the data analysis process.

Research Design

This study was a quantitative ex post facto design to determine the impact of a rotating schedule in a middle school setting on student achievement as measured by the TCAP scores on the Tennessee Department of Education restricted website. The data analyzed were the TCAP scores of individual students from the middle school. The years included 2006-2007 and 2008-2009. The middle school schedule was a traditional seven-period day during the 2006-2007 school years. The school year 2008-2009 was the first full year the school used a rotating schedule. The rotating schedule was implemented mid-way through the 2007-2008 school year. Therefore, no data were included for that school year in this study. Data from both school years were analyzed from the secure state website. Data from the school system's student management system were used to determine students for the study. Only those students who were present both years were used for the study.

Population

The middle school is located in a rural county in central East Tennessee. This school was formed in 1997 when a new high school was built in the county. The teacher turnover rate, as well as the administration, has been low for the short 13 years of this school's existence. There are four elementary schools, one middle school, and one high school in the district. The middle

school served every 6 through 8th grade student who attends public school in the county. The school system population for the year of the study was approximately 3,000. The middle school population was 685 while the cohort population was 235. The free and reduced lunch rate was 65% and the school was 99.9% white. The percentage of students who had an IEP was 18%. The subgroups that counted towards AYP consisted of gender, socioeconomically disadvantaged, and special education. This study involves only those students who were in enrolled and tested in both school years. All students who were in the cohort during the sixth grade and eighth grade years 2006-2009 will be calculated in the study.

Data Collection Procedures

After receiving permission from East Tennessee State University's Institutional Review Board, all data were collected. After receiving the IRB permission, written consent was secured from the school system in which the school is located. The data were obtained through the states' TCAP report. The school system's technology department compiled all student and TCAP data in an excel spreadsheet format and presented it to me with only alpha numerical identifiers representing student names.

Data Analysis

This study was guided by the following two research questions and the null hypothesis that correlate to those questions.

1. Is there a significant difference in TCAP mathematic scores before and after implementation of a rotating schedule?

A series of independent *t* test for independent samples were used to test the following null hypotheses:

$Ho1_1$: There is no significant difference in mathematics TCAP scores of low socioeconomic status students before and after instituting a rotating schedule.

$Ho1_2$ There is no significant difference in mathematics TCAP scores of students with an IEP before and after instituting a rotating schedule.

$Ho1_3$: There is no significant difference in mathematics TCAP scores of male students before and after instituting a rotating schedule.

$Ho1_4$: There is no significant difference in mathematics TCAP scores of female students before and after instituting a rotating schedule.

2. Is there a significant difference in TCAP reading-language art scores before and after implementation of a rotating schedule?

A series of independent t tests for independent samples were used to test the following null hypothesis:

$Ho2_1$: There is no significant difference in reading-language arts TCAP scores of low socioeconomic status students before and after instituting a rotating schedule.

$Ho2_2$ There is no significant difference in reading-language arts TCAP scores of students with an IEP before and after instituting a rotating schedule.

$Ho2_3$: There is no significant difference in reading-language arts TCAP scores of male students before and after instituting a rotating schedule.

$Ho2_4$: There is no significant difference in reading-language arts TCAP scores of female students before and after instituting a rotating schedule.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software. The findings were tested at the .05 level of significance. Because of the number of null hypothesis,

the Bonferroni adjustment procedure was employed. Therefore, the actual level of significance was .05 divided by the number of null hypotheses or .00625

CHAPTER 4

DATA ANALYSIS

The purpose of this quantitative ex post facto study was to determine if a rotating style schedule had any impact on student achievement in the areas of mathematics and reading-language arts. The subgroups examined in this study included the following: low socioeconomic students, students with disability, male, and female. Archival data from the secured state of Tennessee TVAAS system as well as the school system's student data management system were used to collect data for this study.

Descriptive Statistics

Data were collected for those students who were enrolled the sixth grade, 2006-2007 school year and for the same students in the eighth grade in 2008-2009. Only the data for those students who were continuously enrolled and tested both years were included in this study. The cohort consisted of 158 students meeting these criteria. Data for low socioeconomic students and students with disabilities were secured from relevant information on record from the 2006-2007 school terms. Both free and reduced lunch students were included in the count for the low socioeconomic category. The students' normal curve equivalence (NCE) scores were used from both the sixth and eighth grade years. Differences in the two scores indicate growth or lack of progress from one year to the next.

The low socioeconomic students accounted for 78.5% of the cohort in this study. This percent represents 124 students of the 158 in the group. Sixth grade mathematics scores ranged from 1 to 91 with a mean score of a mean score of 52.60. The eighth grade math scores ranged from 8 to 86 with a mean score of 49.72. The sixth grade reading-language arts NCE scores ranged from 1 to 87 with a mean score of 48.62. Eighth grade reading-language arts NCE scores

ranged from 1 to 95 with a mean score of 49.85. Table 1 shows the paired NCE mean sample statistics in mathematics for low socioeconomic students. Table 2 shows the paired NCE mean sample statistics in reading-language arts for low socioeconomic students.

Table 1

Paired NCE mean sample statistics in mathematics for low socioeconomic students

	MEAN	N	Std. Deviation	Std. Error Mean
8th Grade Math	49.72	124	16.76	1.50
6th Grade Math	52.60	124	18.52	1.66

Table 2

Paired NCE mean sample statistics in reading-language arts for low socioeconomic students

	MEAN	N	Std. Deviation	Std. Error Mean
8th Grade Reading-Language Arts	49.85	124	18.20	1.63
6th Grade Reading-Language Arts	48.62	124	21.25	1.91

Those students with an individual education plan (IEP) accounted for 13.3% of the cohort in this study. This percent represents 21 of the 158 students from the group. Sixth grade NCE scores for students with an IEP in mathematics ranged from 1 to 63 and the mean score was 25.76. These students' eighth grade NCE scores ranged from 8 to 64 with a mean score of 27.95. The sixth grade reading-language arts NCE scores ranged from 1 to 67 with a mean score of

25.81. The eighth grade NCE scores for reading-language arts ranged from 1 to 76 with a mean score of 28.57. Table 3 shows the paired NCE mean sample statistics in mathematics for students with an IEP. Table 4 shows the paired NCE mean sample statistics in reading-language arts for students with an IEP.

Table 3

Paired NCE mean sample statistics in mathematics for students with an IEP

	MEAN	N	Std. Deviation	Std. Error Mean
Math 8th Grade	27.95	21	14.85	3.24
Math 6th Grade	25.76	21	17.36	3.79

Table 4

Paired NCE mean sample statistics in reading-language arts for students with an IEP

	MEAN	N	Std. Deviation	Std. Error Mean
8th Grade Reading-Language Arts	28.57	21	18.25	3.98
6th Grade Reading-Language Arts	25.81	21	17.87	3.90

The male students made up 38% of this cohort. This percent equates to 60 of the 158 students in this study. The male student's sixth grade NCE score for mathematics ranged from 1 to 86 with a mean score of 50.27. Their eighth grade NCE scores ranged from 8 to 86 with a

mean score of 46.62. The sixth grade NCE scores for males in reading-language arts ranged from 1 to 87 with a mean score of 44.60. Their eighth grade reading-language arts scores ranged from 1 to 95 with a mean score of 44.78. Table 5 shows the paired NCE mean sample statistics in mathematics for male students. Table 6 shows the paired NCE mean sample statistics in reading-language arts for male students.

Table 5

Paired NCE mean sample statistics in mathematics for male students

	MEAN	N	Std. Deviation	Std. Error Mean
Math 8th Grade	46.62	60	19.01	2.45
Math 6th Grade	50.27	60	21.72	2.80

Table 6

Paired NCE mean sample statistics in reading-language arts for male students

	MEAN	N	Std. Deviation	Std. Error Mean
8th Grade Reading-Language Arts	44.78	60	20.83	2.69
6th Grade Reading-Language Arts	44.60	60	22.15	2.86

The female students made up 62% of the total group. This percent represents 98 of the 158 students in the study group. The sixth grade NCE mathematics scores for females ranged

from 5 to 91 with a mean score of 51.30. Their eighth grade NCE mathematics scores ranged from 13 to 86 with a mean score of 49.20. The sixth grade reading-language arts NCE scores for females ranged from 1 to 92 with a mean score of 49.06. The eighth grade reading-language arts NCE scores ranged from 9 to 95 with a mean score of 51.04. Table 7 shows the paired NCE mean sample statistics in mathematics for female students. Table 8 shows the paired NCE sample statistics in reading-language arts for female students.

Table 7

Paired NCE mean sample statistics in mathematics for female students

	MEAN	N	Std. Deviation	Std. Error Mean
Math 8th Grade	49.20	98	15.26	1.54
Math 6th Grade	51.30	98	16.85	1.70

Table 8

Paired NCE sample statistics in reading-language arts for female students

	MEAN	N	Std. Deviation	Std. Error Mean
8th Grade Reading-Language Arts	51.04	98	16.55	1.67
6th Grade Reading-Language Arts	49.06	98	20.30	2.05

Analysis of Research Questions

Research Question 1

Is there a significant difference in TCAP mathematics scores before and after implementation of a rotating schedule?

$Ho1_1$: There is no significant difference in mathematics TCAP scores of low socioeconomic status students before and after instituting a rotating schedule.

For students of low socioeconomic status an independent *t* test was conducted to evaluate whether there was a difference in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was significant, $t(123) = 3.604$, $p < .001$. Therefore, the null hypothesis was rejected. The TCAP mathematics mean after instituting a rotating schedule ($M = 49.72$, $SD = 16.76$) was almost three points lower than the TCAP mathematics mean prior to the implementation of a rotating schedule ($M = 52.60$, $SD = 18.52$), which is a significant difference. The effect size as measured by η^2 was medium (.10). The 95% confidence interval for the difference between the two means was 4.46 to 1.30. Figure 1 shows the box plots of lower socioeconomic students' TCAP mathematics scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

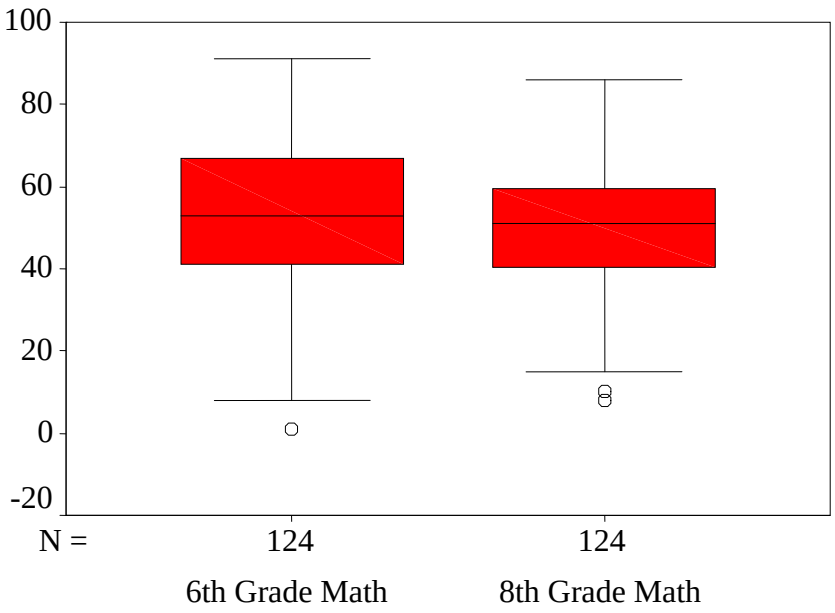
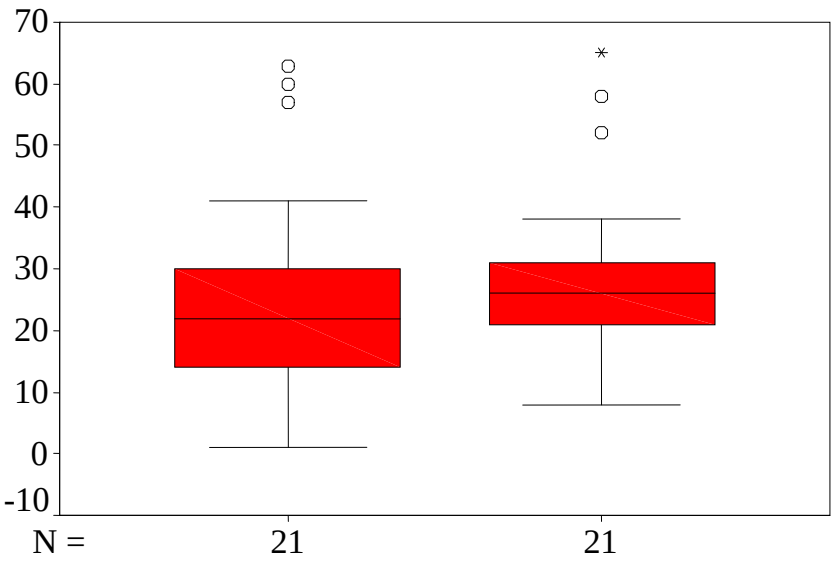


Figure 1. Low socioeconomic students' math scores

Ho1$_2$: There is no significant difference in mathematics TCAP scores of students with an IEP before and after instituting a rotating schedule.

For students with an Individual Education Plan an independent *t* test was conducted to evaluate whether there was a difference in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not significant, t (20) = 1.200, p = .244, ns. Therefore, the null hypothesis was not rejected. The TCAP mathematics mean after instituting a rotating schedule (M = 27.95, SD = 14.85) was over two points higher than the TCAP mathematics mean prior to the implementation of a rotating schedule (M = 25.76, SD = 17.36), which is not a significant difference. The effect size as measured by η^2 was medium (.07). The 95% confidence interval for the difference between the two means was 1.62 to 6.00. Figure 2 shows the box plots of IEP students' TCAP mathematics scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.



o = an observation between 1.5 times to 3.0 times the interquartile range
* = an observation which is more than 3.0 times the interquartile range

Figure 2. Students with an IEP's math scores

Ho1$_3$: There is no significant difference in mathematics TCAP scores of male students before and after instituting a rotating schedule.

For male students an independent *t* test was conducted to evaluate whether there was a difference in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was significant, t (59) = 3.216, p = .002. Therefore, the null hypothesis was rejected. The TCAP mathematics mean after instituting a rotating schedule (M = 46.62, SD = 19.01) was almost four points lower than the TCAP mathematics mean prior to the implementation of a rotating schedule (M = 50.27, SD = 21.72), which is a significant difference. The effect size as measured by η^2 was large (.15). The 95% confidence interval for the difference between the two means was 5.92 to 1.38. Figure 3 shows the box plots of male students' TCAP mathematics scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

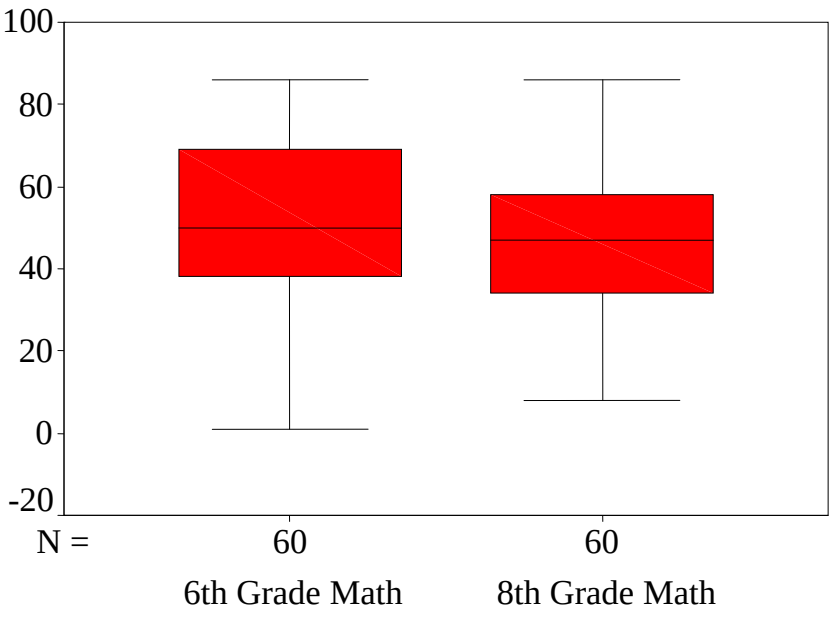


Figure 3. Male student's math scores

Ho1$_4$: There is no significant difference in mathematics TCAP scores of female students before and after instituting a rotating schedule.

For female students an independent *t* test was conducted to evaluate whether there was a difference in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not significant, t (97) = 2.138, p = .035. Therefore, the null hypothesis was not rejected. The TCAP mathematics mean after instituting a rotating schedule (M = 49.20, SD = 15.26) was almost two points lower than the TCAP mathematics mean prior to the implementation of a rotating schedule (M = 51.30, SD = 16.85). The effect size as measured by η^2 was small (.05). The 95% confidence interval for the difference between the two means was 4.03 to .15. Figure 4 shows the box plots of female

students' TCAP mathematics scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

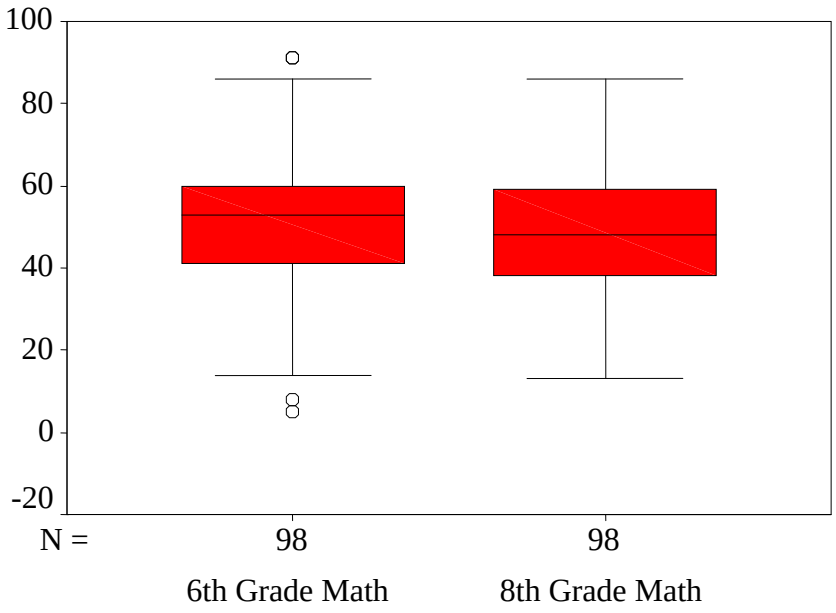


Figure 4. Female student's math scores

Research Question 2

Is there a significant difference in TCAP reading-language arts scores before and after implementation of a rotating schedule?

Ho2$_1$: There is no significant difference in reading-language arts TCAP scores of low socioeconomic status students before and after instituting a rotating schedule.

For students of low socioeconomic status an independent *t* test was conducted to evaluate whether there a difference in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not

significant, t (123) = 1.110, p = .269. Therefore, the null hypothesis was not rejected. The TCAP reading-language arts mean after instituting a rotating schedule (M = 49.85, SD = 18.20) was just over one point higher than the TCAP reading-language arts mean prior to the implementation of a rotating schedule (M = 48.62, SD = 21.25), which is not a significant difference. The effect size as measured by η^2 was small (.01). The 95% confidence interval for the difference between the two means was.97 to 3.44. Figure 5 shows the box plots of lower socioeconomic students' TCAP reading-language arts scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

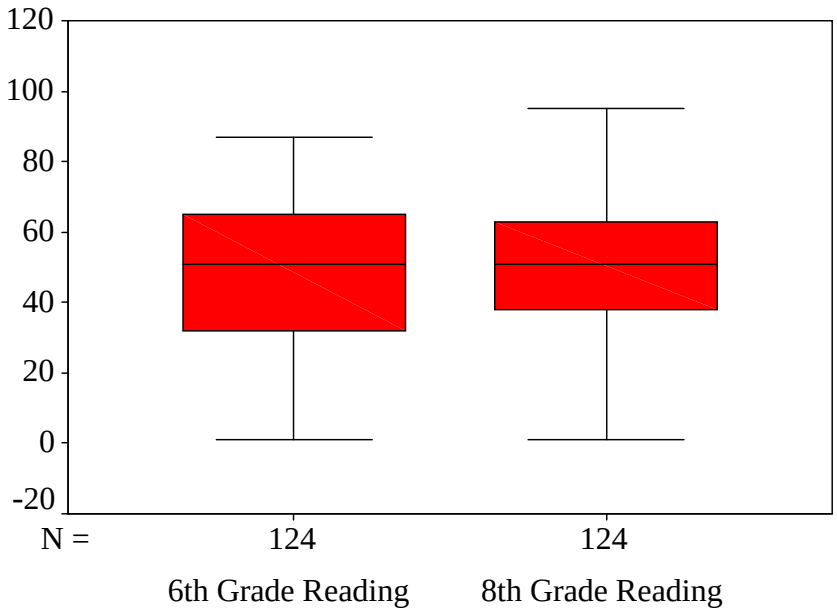


Figure 5. Low socioeconomic students' reading-language arts scores

Ho2_2: There is no significant difference in reading-language arts TCAP scores of students with an IEP before and after instituting a rotating schedule.

For students with an Individual Education Plan an independent *t* test was conducted to evaluate whether there was a difference in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not significant, t (20) = 1.376, p = .184. Therefore, the null hypothesis was not rejected. The TCAP reading-language arts mean after instituting a rotating schedule (M = 28.57, SD = 18.25) was just under three points higher than the TCAP reading-language arts mean prior to the implementation of a rotating schedule (M = 25.81, SD = 17.87) which is not a significant difference. The effect size as measured by η^2 was medium (.09). The 95% confidence interval for the difference between the two means was 1.42 to 6.95. Figure 6 shows the box plots of lower socioeconomic students' TCAP reading-language arts scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

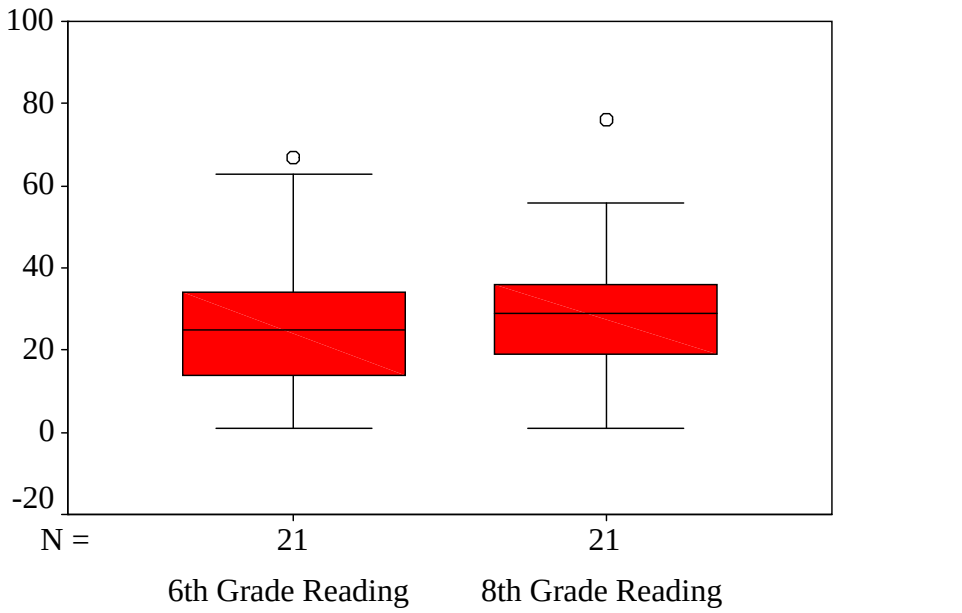


Figure 6. Students with an IEP's reading-language arts scores

$Ho2_3$: There is no significant difference in reading-language arts TCAP scores of male students before and after instituting a rotating schedule.

For male students an independent *t* test was conducted to evaluate whether there was a difference in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not significant, t (59) = .122, p = .903. Therefore, the null hypothesis was not rejected. The TCAP reading-language arts mean after instituting a rotating schedule (M = 44.78, SD = 20.83) was just slightly higher than the TCAP reading-language arts mean prior to the implementation of a rotating schedule (M = 44.60, SD = 22.15), which is not a significant difference. The effect size as measured by η^2 was small (<.01). The 95% confidence interval for the difference between the two means was 2.81 to 3.18. Figure 7 shows the box plots of male students' TCAP reading-language arts scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule.

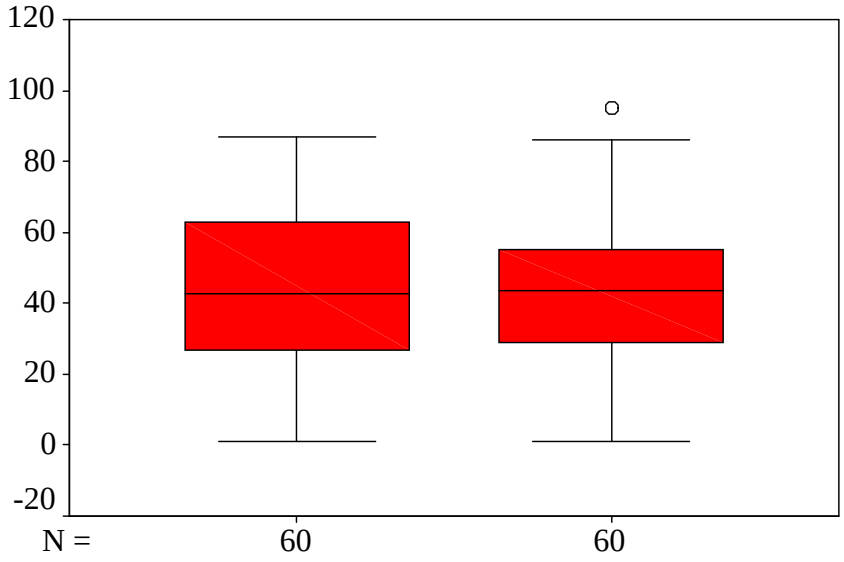


Figure 7. Male student's reading-language arts scores

$Ho2_4$: There is no significant difference in reading-language arts TCAP scores of female students before and after instituting a rotating schedule.

For female students an independent *t* test was conducted to evaluate whether there was a difference in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. The independent *t* test was not significant, t (97) = 1.482, p = .142. Therefore, the null hypothesis was not rejected. The TCAP reading-language arts mean after instituting a rotating schedule (M = 51.04, SD = 16.55) was almost two points higher than the TCAP reading-language arts mean prior to the implementation of a rotating schedule (M = 49.06, SD = 20.30), which is not a significant difference. The effect size as measured by η^2 was small (.02). The 95% confidence interval for the difference between the two means was.67to 4.63. Figure 8 shows the box plots of female students' TCAP reading-language arts scores before (sixth grade) and after (eighth grade) the implementation of a rotating schedule. Table 9 shows the effect size for the hypothesis in each subgroup and subject.

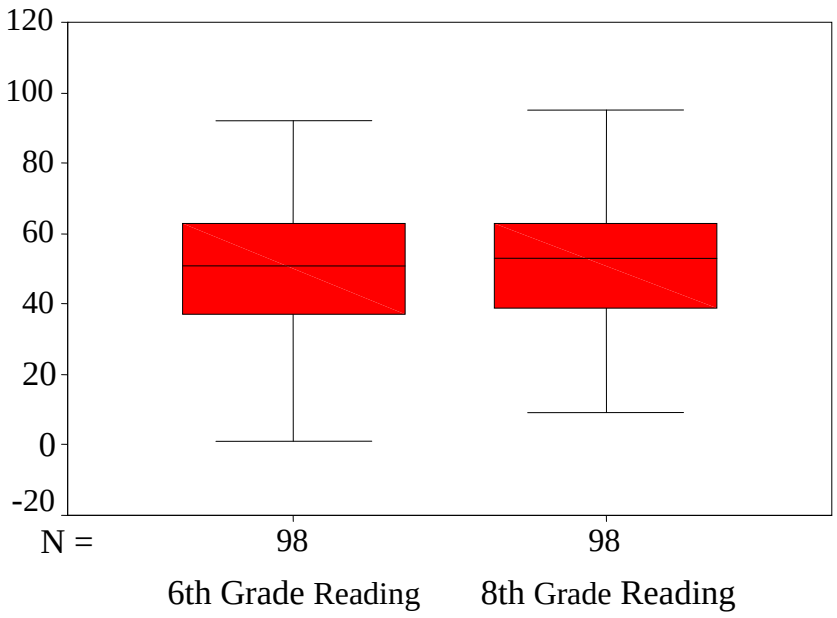


Figure 8. Female student's reading-language arts scores

Table 9

Effect size for hypotheses

Hypothesis for:	Paired *t* was	Higher mean	Eta^2 effect size (η^2)	Interpretation
Low SES Math	significant	6th grade	.095 (.10)	medium
Low SES Reading-Lang Arts	Not significant	8th grade	.010 (.01)	small
Special Education Students Math	Not significant	8th grade	.067 (.07)	medium
Special Education Students Reading-Lang Arts	Not significant	8th grade	.086 (.09)	medium
Males Math	Significant	6th grade	.149 (.15)	large
Males Reading-Lang Arts	Not significant	8th grade	<.001 (<.01)	small
Females Math	Significant	6th grade	.045 (.05)	small
Females reading-language arts	Not significant	8th grade	.022 (.02)	small

The data presented in chapter 4 give a breakdown of the four subgroups which are represented in a rural East Tennessee middle school. The subgroups in this study are low socioeconomic students, students with an individual education plan, male students, and female students. Information in this chapter gives some insight into the effectiveness of this middle school's schedule as it relates to student achievement. The figures present a representation of how students in the various subgroups progressed from sixth grade to eighth grade while using a rotating schedule. The tables offer information about the mean, standard deviation, and number

tested. The final table offers information from each subgroup and subject concerning the significance of the test as well as the interpretation of the groups.

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine if a rotating schedule impacted student achievement. Subgroups examined in this study included low socioeconomic students, students with an IEP, as well as male and female students. Student achievement was determined by gains or loss over a 3-year period in the normal curve equivalence in mathematics and reading-language arts Tennessee Comprehensive Assessment Program (TCAP) test administered at the end of each school year. Normal curve equivalence (NCE) scores were gathered from the 2006-2007 sixth grade students beginning their school year and their eighth grade 2008-2009 school year. Only those students who were continuously enrolled and tested both years were included in this study. The student's sixth grade year was used as a baseline when considering placement in the low socioeconomic and students with an IEP categories. Data were analyzed on both the sixth grade and eighth grade years to determine student growth. Data were collected from both the student data management system and the Tennessee Department of Education secure TVAAS website.

Summary of the Study

The impact of a rotating schedule in a middle school setting on student achievement on subgroups (low socioeconomic students, students with an IEP, male and female students) was examined in this study. Two research questions for each of the four subgroups were used. A series of independent *t* test were conducted to evaluate whether there was a difference in the TCAP scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. Mathematics and reading-language arts scores were used to determine student success.

Summary of Findings

The statistical analysis centered on two research questions on each of the four sub-groups. Those two questions are presented below.

Research Question 1

Is there a significant difference in TCAP mathematics scores before and after implementation of a rotating schedule?

An independent *t* test was conducted to evaluate whether there was a difference for students of low socioeconomic status in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was a significant relationship between a rotating schedule and student achievement. The TCAP mathematics mean for low socioeconomic students after instituting a rotating schedule was 49.72 compared to a mean of 52.60 before instituting the rotating schedule. The results were a loss of over two points.

An independent *t* test was conducted to evaluate whether there was a difference for students with an IEP in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was not a significant relationship between a rotating schedule and student achievement. The TCAP mathematics mean for students with an IEP after instituting a rotating schedule was 27.95 compared to a mean of 25.76 before instituting the rotating schedule. The results were a gain of over two points.

An independent *t* test was conducted to evaluate whether there was a difference for male students in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was a significant relationship between a rotating schedule and student achievement. The TCAP mathematics mean for male students after

instituting a rotating schedule was 46.62 compared to a mean of 50.27 before instituting the rotating schedule. The results were a loss of over three points.

An independent *t* test was conducted to evaluate whether there was a difference for female students in the TCAP mathematics scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was a significant relationship between a rotating schedule and student achievement. The TCAP mathematics mean for female students with an IEP after instituting a rotating schedule was 49.20 compared to a mean of 51.30 before instituting the rotating schedule. The results were a loss of over one point.

Research Question 2

Is there a significant difference in TCAP reading-language arts scores before and after implementation of a rotating schedule?

An independent *t* test was conducted to evaluate whether there was a difference for students of low socioeconomic status in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was not a significant relationship between a rotating schedule and student achievement. The TCAP reading-language arts mean for low socioeconomic students after instituting a rotating schedule was 49.85 compared to a mean of 48.62 before instituting the rotating schedule. The results were a gain of over one point.

An independent *t* test was conducted to evaluate whether there was a difference for students with an IEP in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was not a significant relationship between a rotating schedule and student achievement. The TCAP reading-language

arts mean for students with an IEP after instituting a rotating schedule was 28.57 compared to a mean of 25.81 before instituting the rotating schedule. The results were a gain of over two points.

An independent *t* test was conducted to evaluate whether there was a difference for male students in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was not a significant relationship between a rotating schedule and student achievement. The TCAP reading-language arts mean for male students after instituting a rotating schedule was 44.78 compared to a mean of 44.60 before instituting the rotating schedule. The results were a gain of less than one point.

An independent *t* test was conducted to evaluate whether there was a difference for female students in the TCAP reading-language arts scores before (sixth grade scores) and after (eighth grade scores) instituting a rotating schedule. There was not a significant relationship between a rotating schedule and student achievement. The TCAP reading-language arts mean for female students after instituting a rotating schedule was 51.04 compared to a mean of 49.06 before instituting the rotating schedule. The results were a gain of over one point.

Conclusion

There has been very little current research as to the effect of circadian rhythms and brain research as it relates to middle school scheduling. Research that has been conducted reveals that students perform best at different times of the day. Wolfson and Carskadon (2003) found that there was a relationship between sleep patterns and student performance. Age as well as the individual student's ability plays an important role in determining the optimum time for student achievement. Bruer (2010) reported the windows of opportunity for a solid foundation of

knowledge are acquired between the ages of 2 and 11. This data becomes extremely pertinent when determining an effective schedule for students and schools.

This study revealed that not all students made progress while using a rotating schedule. In fact, in some instances the NCE scores dropped for some subgroups. Close evaluation of the data reveals that only the students with an IEP made gains in mathematics. Conversely, each subgroup demonstrated limited to substantial growth in reading-language arts. The increase for reading-language arts ranged from over one point to nearly three points with the most significant gain being students with an IEP. This information substantiates Klien's (2004) research findings that there was an increase in students' level of achievement in reading when classes were offered at different times of the day in a middle school setting.

The era of accountability has ushered in challenges and opportunities for educators. The added pressure for teachers and administrators to increase student achievement is a daunting task. With accountability there are added data. When used effectively, these data may be used to evaluate curriculum, teaching strategies, and scheduling methods. It is imperative that educators not only understand the data but also use them to determine the effectiveness of their programs.

The school in this study made adequate yearly progress (AYP) after the implementation of a rotating schedule. The initiative was suggested by a concerned parent whose child generally made high marks in reading. However, during the first semester of his seventh grade year, his grades dropped significantly in reading, which was his last class of the day. Concerned for her son's progress, she approached the principal and asked that her son be moved to an earlier period because she felt that he performed at a higher level in the morning hours. The principal honored the parent request but also began to research different scheduling schemes. The change in

scheduling was a difficult one especially for the staff. After implementing a rotating schedule, both students and teachers agreed that this was singularly one of the most significantly positive changes for the school. This was evident in the surveys conducted annually recorded in the school improvement plan. The rotating schedule remains in effect for the school to date.

The most noted positive effect for this middle school was the decrease in discipline for afternoon inclusionary classes. Not only did the discipline fall, the progress of the students with an individual education plan rose significantly. This held true for both reading-language arts and mathematics. Teachers throughout the building commented that they believed this occurred because the students now had an opportunity to have these subjects at different times of the day throughout the week.

Recommendations for Practice

This study showed a mixture of success and challenges when using a rotating schedule. The group with the marked increase in both reading-language arts and mathematics was those students with an IEP. Although the study revealed that there was not a significant relationship between the rotating schedule and student achievement, there was an increase in NCE scores for each of the four subgroups studied in reading-language arts. Administrators should research the circadian rhythm changes in adolescence. Further, administrators should inform directors and board members about the effects of school starting times at the various grade levels and its impact on student achievement as a result in changing circadian rhythms. Often, school schedules revolve around the needs of the adults in the building and are seen as a part of the school culture that cannot be changed. Schedules should reflect the need of students and be evaluated from time to time as the need arises. Each school would benefit from a team of data experts who serve to evaluate the effectiveness of its schedule as well as other aspects of the

school. These teams should be objective and unbiased to ensure that student needs are being met. Administrators must keep abreast of the current research and practices of highly effective school scheduling. Rarely are two middle school schedules the same. Administrators should have the opportunity to visit schools that have shown progress in academic achievement to evaluate schedules. School schedules should be the responsibility of stakeholders with a shared vision reflecting student needs. Educators and administrators should keep an open mind to change when it comes to innovative ideas and practice.

When considering change in any schedule configuration, administrators should first consider what works well for their school and get input from those who the schedule affects. The teachers and students in the school from this study were apprehensive when discussing change to a rotating schedule. After months of planning and organizational meetings, the administration and teachers decided to make a change. The rotating schedule has been implemented in this middle school for 5 years and has been extremely successful. The success is not simply measured by test scores. It is measured by the change in attitude of teachers. They believe that this schedule configuration, which gives them the opportunity to see each of their students at different times of the day during the week, accounts for the drop in discipline at the end of the day. Further, inclusionary classes were more engaged in learning after the change to a rotating schedule. The most significant obstacle of this type of schedule was adults being able to adapt to it.

Recommendations for Further Research

No Child Left Behind holds all educators and administrators accountable for the performance of every child. This requirement forces all school systems to be aware of learning styles including the time of the day a student performs at his or her peak. Some schools are

considering this information and changing school start times for high schools in their district. Research indicates that this is a move in a positive direction; however, circadian rhythms affect middle school students as well as high school students. As school systems work toward ensuring students are given the opportunity to learn at their optimum time of day, they may consider alternative scheduling and other research in this area. Suggestions for further research include but are not limited to the following:

1. Continued research should be conducted in the area of circadian rhythms and sleep patterns of students at various ages.
2. Further research should be conducted in the area of how school schedules affect student achievement.
3. Research should include school start times at the various grade levels.
4. Each subject area should be further examined to understand the effects of circadian rhythms on student achievement.
5. Further research should be conducted on circadian rhythms and its effects on student achievement by subgroups.
6. Longitudinal studies should be conducted to analyze different scheduling configurations.
7. This study was conducted in a rural setting. Further studies should be conducted in other rural settings as well as urban areas.
8. Qualitative studies should be conducted to secure teacher and parent attitudes in scheduling options. Further, student surveys should be included in studies to determine their morningness or eveningness preference.

Research indicates that learning is a complex process and there is a variety of learning styles. Today's educators are being trained in learning styles and differentiated instruction. Circadian

rhythm research is a relatively new concept that gained much attention in the 1990s. This research suggests that children have an optimum time of day in which they learn best. Further, students process information differently as they progress through the stages of development. This information may be beneficial to administrators and educators as they prepare a master schedule. Often, school schedules are dictated by the needs of adults and the configuration of the school operation. Knowing that students have different learning styles, differentiation of time to meet student's morningness and eveningness needs may be the next step for administrators to consider when preparing students to meet their full potential. Educators must continue to investigate the tenets of brain based education and use those shown to be advantageous to learning.

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