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The effects of scheduling modes on high school student achievement in Iowa

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The effects of scheduling modes on high school student achievement in Iowa

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ABSTRACT

This study was conducted to determine whether scheduling interventions make a difference in student achievement. It examined the effects of scheduling types on Iowa Tests of Educational Development (ITED) scores in Iowa high schools. Student performance, as measured by ITED scores, was used to compare 4×4 block-scheduled schools, A/B alternating-day block-scheduled schools, 8-period day scheduled schools, and the Iowa state norms. An analysis of covariance was used as the analytical procedure. The ANCOVA factored in both school size and gender. The battery of ITED scores used for comparison included reading, mathematics, science, social studies, and composite scores. This study suggests that there is no significant difference in student performance as measured by the Iowa Tests of Educational Development in Iowa schools using a 4×4 or an A/B block-schedule. No significant difference was found in all but three of the tests when comparing students in schools using a traditional 8-period day schedule and students in either a 4×4 or an A/B block scheduled school.

One unique aspect of this study was the comparison of the ITED scores in the year prior to implementation of a block schedule with the 1999 ITED scores of the same school. Only schools that had been on block scheduling two or more years were selected for the study. This longevity component suggests that the ITED mean scores of schools will increase, although not significantly, after the conversion to an A/B block schedule. The same results were not produced with a 4×4 schedule.

Another pattern that developed throughout the course of the hypothesis testing was the fact that the variability of scores in the block schools was consistently greater than in the traditionally scheduled schools. When factoring in gender, the range in standard deviations primarily was due to the wide differences in males' mean scores.

Size of the school had little effect on student performance on the ITED. There was a positive correlation between mean scores on the ITED and school size. As schools increased in size, the ITED mean scores rose, but except in one hypothesis test, these differences were not significant.

CHAPTER I. INTRODUCTION

> "As Oliver Hazard Perry said in a famous dispatch from the War of 1812: 'We have met the enemy and they are [h]ours.' " (NECTL, 1994, p. 7)

For a large majority of our American schools, how time is parceled out during any given day has remained unchanged despite a transformation in the world around them (National Education Commission on Time and Learning (NECTL), 1994). According to Anderson (1994), researchers have identified four components of time: allocated time, instructional time, time-on-task, and academic learning time. Administrators build schedules for schools to allocate time for learning. Teachers prepare a lesson design and have control over the amount of instructional time. The learning environment and classroom management impact the length of time-on-task. Academic learning time is the time needed by the student to transfer the information received in a lesson into meaningful knowledge, followed by the ability to both demonstrate and apply it. Time utilization is a key component for any attempt to restructure schools. It is also a resource that educators can control (Carroll, 1994a).

According to the National Association of Secondary School Principals' (NASSP) Commission on Restructuring (1992), school restructuring is defined as "...the reforming of school organization relationships and processes to increase student learning and performance..." (p. 3). Scheduling is a major component of restructuring (Boyer, 1983; Cawelti, 1995; Goodlad, 1983; Sizer, 1984). Boyer (1983) surmised that more time for instruction was not as important as the need for better use of existing time. In the report *Prisoners of Time*, NECTL (1994) concluded that there is no point in adding more time to the school day, if it is going to be used in the same way. Goodlad (1983) concluded that when schools are scheduled into classes by subject and for short periods of time, memorization and not conceptualization takes place. Sizer (1984) reported that when better school structures are created, better schools will result. When considering constructing a new schedule, two factors should be paramount in driving the change: the educational needs of the student population and state-mandated graduation requirements (Whitfield, 1999).

A major component to improve instruction in schools is to understand the relationship between time and learning. The daily time structure of a secondary school affects the very climate and culture of the building. The master schedule says much about the beliefs and values of a school. Student achievement, curriculum offerings, teaching pedagogy, student time-on-task, teacher workloads, student discipline, and teacher/facility utilization are directly affected by the type of master schedule used in a school. It can create opportunities or barriers for student learning (Williamson, 1993). The problem is not new. U.S. Commissioner of Education, William T. Harris expressed his frustration in 1894 over a loss of time in the public school:

> The constant tendency has been toward a reduction of time. First, the Saturday morning session was discontinued; then the summer vacations were lengthened; the morning sessions were shortened; the afternoon sessions were curtailed; new holidays were introduced; provisions were made for a single session on stormy days, and for closing the schools to allow teachers…to attend teachers' institutes…
>
> The boy of today must attend school 11.1 years in order to receive as much instruction quantitatively, as the boy of fifty years ago received in 8 years… It is scarcely necessary to look further than this for the explanation for the greater amount of work accomplished…in the German and French than in the American schools… (NECTL, 1994, p. 10)

A "traditional" scheduled high school consists of a six-, seven-, or eight-period day with periods ranging from 40 minutes to one hour in length. In a seven-period daily schedule, students are enrolled in an average of five or six classes. Teachers may teach as many as six classes and be responsible for 150-180 students. This generally accepted model of scheduling was compatible with the Carnegie Unit. The 1960s produced the largest amount of literature on modifying the secondary school schedule (Traverso, 1991), although few modifications to the traditional model emerged from this focus of study.

Trump's model of modular scheduling gained acceptance in the middle 1960s, but faded quickly (MacIver, 1992). It assigned one or more 10- to 20-minute modules to particular teaching and learning tasks. An individual study session may be one module in length, whereas a lecture session may be four modules long.

One alternative method of scheduling that has gained in popularity is block scheduling. With the block configuration, class sessions are approximately double in length as compared to that of a traditional class. The day typically is divided into four blocks of time. Students take an average of three classes per day for 80-110 minutes each. Teachers teach three out of the four blocks (Canady & Rettig, 1999). In a 4×4 block schedule, a student will take a class every day, and is able to complete a semester equivalent class in one quarter and/or a yearlong class in one semester. In an A/B alternating block schedule, the student would take a yearlong class every other day for 80-100 minutes (Canady & Rettig, 1999). If a school was organized on a six- or seven-period schedule, changing to a block schedule would allow more course offerings, equivalent to the number offered by an eight-period day. One of the eight recommendations by NECTL (1984) was to "fix the design flaw" (p. 17) in schools by relying much less on a 51-minute period and moving to the adoption of a block schedule.

Statement of Problem

The basic premise used in this study is that scheduling methodology has an effect on the educational process (Dempsey & Traverso, 1983). If not, there would be little incentive for educators to consider variations in schedule types. The problem investigated was to determine whether scheduling interventions make a difference in student achievement. The study examined the effects of the characteristics of scheduling types on Iowa Tests of Educational Development scores in Iowa secondary schools. The focus was on the implementation of block scheduling as a scheduling model.

The Comprehensive School Improvement Plan

Why should student performance on standardized tests be a determining factor for the conversion to block scheduling? Iowa is the only state in the United States that does not have mandated state standards that can be used to assess student performance. The Iowa legislature has given this responsibility to the local school boards. A new piece of Iowa State legislation (Iowa Code, 1999) has directed the Iowa Department of Education to hold school districts accountable for measurable gains in student learning. Each school district is to develop a Comprehensive School Improvement Plan (CSIP), specific to its local setting, that is designed to increase the academic performance of all students (I.A.C., 1999).

The first multiyear CSIP plan was due to the Iowa Department of Education on or before September 15, 2000, and an annual progress report every September 15 thereafter (I.A.C., 1999). The CSIP must include provisions for community involvement, data collection, analysis, and goal setting, standards and benchmarks, reporting on state indicators, assessment of student progress, and annual progress report. The CSIP is to be designed for continuous school, parental, and community involvement in the development and monitoring of a plan that is aligned with school- and/or school district-determined needs. This plan must contain provisions for district-wide assessment of academic progress for all students in reading, mathematics, and science using valid and reliable student assessments aligned with local content standards.

One of the assessment components called for in Chapter 12 of this legislation involves the use of a standardized norm-referenced assessment instrument:

> Using at least one district wide assessment, a school or school district shall assess student progress on the state indicators in, but not limited to, reading, mathematics, and science ... At least one district wide assessment shall allow for but not be limited to, the comparison of the school or school district's students with students from across the state and in the nation in reading, mathematics, and science. (I.A.C.12.8, p. 21)

Iowa Code (1999) has mandated that this comparison in student performance is to take place in grades four, eight, and eleven. As a result, there has been an increase in the number of schools administering the Iowa Tests of Basic Skill (ITBS) and the Iowa Tests of Educational Development (ITED) as the standardized norm-reference tests used to measure and compare student achievement (Iowa Testing Programs, 1999a).

Iowa Tests of Educational Development

Standardized achievement tests have played a major role in educational settings because they assist test users in evaluating the impact of change due to educational programs and curriculum. Normative information of these tests can provide useful information to facilitate placement, diagnostic and remedial, guidance, selection, curricular, and public policy decisions (Thorndike, Cunningham, Thorndike, & Hagen, 1991).

The Iowa Tests of Educational Development (ITED) is a commonly used standardized achievement instrument to measure the academic growth and performance of high school students. It is intended to measure students' achievement in the skills that reflect some of the major goals of secondary education. Feldt, Forsyth, Ansley, and Alnot (1994) state that these skills consist of recognizing the essentials of correct and effective writing, solving quantitative problems, interpreting a wide variety of reading materials (both literary and informational), critically analyzing discussions of social issues and reports on scientific matters, recognizing sound methods of scientific inquiry, and using sources of information. Three levels of ITED have been developed: Level 15 for grade 9 students, Level 16 for grade 10 students, and Level 17/18 for grade 11/12 students. Since grade 11 is the targeted class being compared, Level 17/18 was used as the instrument for this study.

The actual ITED consists of seven subtests: (1) Vocabulary (V); (2) Ability to Interpret Literary Materials (L); (3) Correctness and Appropriateness of Expression (E); (4) Ability to Do Quantitative Thinking (Q); (5) Analysis of Social Studies Materials (SS); (6) Analysis of Science Materials (SC); and (7) Use of Sources of Information (SI). The Composite Score (CC) is the average of the seven tests. One additional test this study examined and compared was the Content Area Reading Score (CAR). It is derived from a subset of questions in Test L, Test SS, and Test SC. The CAR test questions require the student to construct meaning from the passages taken from these three tests (Feldt et al., 1994).

Currently, three forms of the ITED are available (Form K, L, and M). ITED scores are reported in the following forms: raw, percent, grade equivalent, developmental standard, percentile rank, stanine, and norm curve equivalent (Jones, 1997). The publishers of the Iowa

Tests of Educational Development explain its purposes in the *Primary user's manual forms K and L* (University of Iowa Testing Program, 1993):

> The primary purpose for using a standardized achievement battery is to gather information that can be used to improve instruction. *The Iowa Test of Educational Development* does not purport to measure all the worthwhile objectives of the secondary curriculum; the diversity of instructional methods and materials makes it impractical for any test to attempt to do that. However, there are a number of generally held objectives toward which all students are expected to progress as they go through high school, regardless of the specific courses they take or the curriculum they may be following.... *The Iowa Test of Educational Development* looks beyond the specific courses schools use in developing these various competencies. The tests present a carefully selected sample of tasks that require students to apply their knowledge and skills in new situations.... Because the normative data for all tests are based on the same sample of schools, relative strengths and weaknesses in the local program can be disconcerned.... Thus, the results from the ITED can be a uniquely useful complement to other sources of information about students' educational development. (pp. 4-5)

In the 1999-2000 school year, 369 of the 393 of the public and nonpublic high schools in Iowa administered the ITED to one or more grades (Iowa Testing Programs, 1999a). The number of 11th grade students in Iowa that have taken the ITED has increased from 27,462 in 1993 to 34,483 in 1999 (1999a). Table 1 reports the number of students in all years from 1993 through 1999.

Table 1 Number of 11th grade Iowa students taking the ITED

Year	Number of students
1993	27,462
1994	28,179
1995	27,662
1996	26,698
1997	29,609
1998	32,952
1999	34,483

Need for the Study

As school officials contemplate whether to switch from a traditional structure to a block format, they need a make an informed choice that is researched-based, supported by studies using a quantitative methodology. The essential goal of block scheduling is not merely to improve the environment and structure where both teachers and students have manageable workloads, but also to improve student performance. This is a serious concern raised about block scheduling. Do students learn as well or better than students following a traditional schedule? There is insufficient research measuring student achievement (Canady & Rettig, 1995; Edwards, 1995; Whitfield, 1999). Sommerfeld (1996) reported the concern of one Maine principal, "Because block scheduling has become relatively common only in the past few years, there are not many multi-school studies that use recognized instruments such as the Scholastic Assessment Test or state exams to gauge changes in student achievement" (p. 15).

Thus, the current study attempted to measure any changes in student achievement due to block scheduling. During the 1999-2000 school year, Hackmann (in press) updated his 1998-1999 survey (Hackmann, 1999a) of the 393 public and nonpublic high schools in Iowa. The purpose of the Hackmann study was to identify the current scheduling type used by Iowa schools. Over 72% of Iowa secondary schools were using a traditional six- to ten-period day structure, with the eight-period day being the most popular (54.2%). The results of the survey found that 52 schools were using an A/B alternating block schedule and 32 were using a 4×4 block structure. Only 25.9% of Iowa's secondary schools used some form of block scheduling. This was an increase of 4.3% over the previous year (Hackmann, 1999a). Forty-one schools indicated they were considering a conversion to a block model (Hackmann, in press). If all of the schools followed through with the restructuring, fewer than 37% of the Iowa schools would utilize some form of block scheduling. Rettig and Canady (1999) estimated that 30% of the nation's secondary schools are using block scheduling, although the percentage is as high as 67% in some states such as Virginia and North Carolina.

Hackmann (1999a) listed several reasons why Iowa may be moving at a cautious pace when compared to other states. One such reason he suggested is that "the correlation between block scheduling and student achievement has not been fully established" (p. 74). Traditionally, Iowa students score well on the American College Testing (ACT) standardized exams, finishing third in the nation in1998 (ACT, 1998). Hackmann surmised that principals are reluctant to change from a traditional to a block schedule until more research has been completed indicating a positive correlation between an increase in standardized test scores and block scheduling. To date, few hard quantitative studies exist. If schools are going to continue to implement block scheduling, all stakeholders (school boards, administrators, teachers, parents, and students) need to know the effect of this schedule on student performance.

Purpose of Study

The purpose of the study was to determine whether or not scheduling interventions have an effect on student achievement. The study attempted to determine whether schools using different scheduling models have different scores on the Iowa Tests of Educational Development (ITED). In Iowa, 31 schools used a 4×4 block schedule during the 1998-1999 school year, of which 19 administered the ITED to 11th grade students. Thirty-four of the 50 schools that used an A/B alternating-day block structure administered the ITED to 11th grade students.

For this study, block scheduling was the treatment. Pre-treatment ITED scores were compared with post-treatment scores. The first aspect of the study described the extent to which ITED scores changed due to the implementation of block scheduling. The study also compared 4×4 and A/B treatment schools' scores with each other, state means, and traditional eight-period day scheduled schools. The second aspect of the study described the differences, if any, in these scores and whether or not such differences explained any impact of scheduling practices.

Research Questions

Two research questions were developed to guide the study:

1. What is the effect of block scheduling on academic student achievement in Iowa high schools as measured by the Iowa Tests of Educational Development (ITED)?
    a. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on a 4×4 block schedule and 11th grade students on an A/B block schedule?
    b. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on a 4×4 block schedule and 11th grade students on an eight-period day schedule?

c. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on an A/B block schedule and 11th grade students on an eight-period day schedule?

d. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on a 4 x 4 block schedule and the Iowa state mean for 11th grade students?

e. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on an A/B block schedule and the Iowa state mean for 11th grade students?

f. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Test of Educational Development between 11th grade students on a 4 x 4 block schedule and on 11th grade students before adoption of the block schedule in the same school?

g. Is there a difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Test of Educational Development between 11th grade students on an A/B block schedule and on 11th grade students before adoption of the block schedule in the same school?

2. Are these differences affected by the size of school and/or gender?

Assumptions of the Study

The following assumptions were made pursuant to the study:

1. Scores on Iowa Test of Educational Development provide an accurate measure of academic performance.
2. The distribution of demographic characteristics in terms of size, ethnicity, and socio-economic status of a particular school studied remained the same over the years measured.
3. School districts reported out student results consistently over the measured time period.

Limitations of the Study

The following limitations were inherent in this study:

1. The staff development needed to prepare teachers to implement block scheduling was not studied.
2. The different types of instructional methods used in the classroom that might contribute to increased standardized test scores were not studied.
3. The sample of schools studied may not be representative of all schools in Iowa.
4. The Iowa Test of Educational Development may not be completely aligned with the school district's curriculum.

Definition of Terms

Several terms used throughout the study are defined as follows:

4×4 Semester Plan: The day is divided into four blocks of time, normally 90 minutes in length, and meets every day during a semester. In a 4×4 block schedule, information in a traditional yearlong course would be covered in one semester. A teacher would teach three classes and see only half as many students on a given day, as compared to a traditional schedule. Students would take only half as many classes per day (Hamdy, 1996). A 4×4 block schedule is illustrated in Figure 1.

Alternate Days Schedule (also known as A/B Block or Day 1/Day 2 Block): The day is divided in to four 90-minute blocks. Students can register for six to eight classes. Classes meet for one block every other day. Teachers would teach six blocks every two days. Teachers would be responsible for an average of between 75-90 students per day. A class offered on an A/B block schedule would meet every other day all year long (Morris, 1997). An alternate days schedule is illustrated in Figure 2.

Block Schedule: Any form of high school schedule format in which the common purpose is to allow students to spend longer periods of time concentrating on fewer subjects during any one day. Class periods typically are 90 minutes or longer (Vawter, 1999).

[illegible]	[illegible]	Block Scheduling Semester 2
1	Course 1	Course 5
2		
3	Course 2	Course 6
4		
5	Course 3	Course 7
6		
7	Course 4	Course 8
8		

Figure 1. 4×4 block schedule

[illegible]	[illegible]	Block Scheduling Day B
1	Course 1	Course 5
2		
3	Course 2	Course 6
4		
5	Course 3	Course 7
6		
7	Course 4	Course 8
8		

Figure 2. Alternate days schedule

Traditional Scheduling Method: A common scheduling method used for the majority of the 20th century where the school day is divided into six, seven, or eight periods each day of a semester and/or school year. Each class period typically ranges between 40-55 minutes in length (Whitfield, 1999).

CHAPTER II. REVIEW OF LITERATURE

Research for the review of literature pertaining to this study was accessed through the Educational Research Service (ERS), Educational Research Information Center (ERIC), Dissertation Abstracts, International Abstracts, Library Indexes and experts in the field. This material provided a wealth of information in the area of block scheduling. It also revealed a shortage of hard quantitative data on the impact of block scheduling on academic performance. One objective for the study was to add to the body of existing knowledge, a quantitative study that examines the potential effect of scheduling types used in secondary schools on student achievement, as measured by a norm-referenced standardized test.

The literature review for this study begins by looking at the historical background of the scheduling types used in high schools from the turn of the 20th century to the present. It examines the origin and impact of the Carnegie unit and weaves in the political and social climate of the time that leads to various attempts at school restructuring. This section ends with the inception of block scheduling. The review continues with an in-depth analysis of block scheduling—its advantages supported by related research and its disadvantages countered by solutions. Intertwined is a look at the merits of a constructivist classroom. The elements needed for the successful implementation of block scheduling are discussed. A close look at the appropriate uses and pitfalls of norm-referenced, standardized tests follows. The review ends with a review of related research involving standardized testing.

Historical Background

For three-quarters of the 20th century the basic time structure of an American high school remained the same (Carroll, 1990). A report by the National Education Association's

(NEA) Committee of Ten led to a rigid high school schedule centered on the five or six academic areas, on which a student would need to focus during each of the four years of high school (Gorman, 1971). In 1905, the Carnegie Foundation for the Advancement of Teaching suggested the Carnegie Unit as a way to standardize high school instruction, thus giving colleges an objective way to compare transcripts of potential students and set the number of seat-time hours needed for a subject to be counted as a credit. Kruse and Kruse (1995) reported that the Carnegie Unit had its roots in time studies conducted to improve efficiency in factories in the early part of the century. A "factory like" system of education evolved, resulting in the six- or seven- period day schedule becoming the standard.

Modular scheduling

Throughout the 20th century many efforts to change the time constraints of the secondary school structure have been attempted, yet most failed. According to King (1996), the Dalton Plan of 1921 and the Tremestie Plan of 1946 were two early attempts to increase instructional time by lengthening class periods. Lack of supervision for the large amounts of time that these structures created led to disciplinary problems and eventually the participating schools returned to the traditional schedule (King).

In the 1960s, one failed attempt at restructuring the secondary school day was "flexible modular scheduling." J. Lloyd Trump is generally credited for the development and implementation of the modular scheduling approach in the late 1950s (Hackmann, 1999a). The Western States Small School Project defined Modular Scheduling as follows:

> Modular Scheduling divides the school day into equal units that are considerably shorter than the traditional 55-minute class periods. The shorter units called "modules" are arranged in various combinations to serve the

> variety of individual requests of students' and teachers' time, spaces and grouping. (Jesser & Stutz, 1966, p. 2)

Four types of basic instruction models are utilized expending one or more modules: laboratory, independent and individualized, and small group instruction. All of these follow information provided to the students in large group instruction (Bush & Allen, 1964). The number of modules assigned to a specific instruction model parallels the amount of time needed to accomplish its intended purpose. A biology class might meet in a large group for six 10-minute modules, followed by three 10-minutes modules for small group discussion or debriefing. The next day might include six 10-minute blocks for a lab experiment. The students would have smaller amounts of time scheduled for individual help or independent study to write up the lab report.

Modular scheduling spread quickly. By the early 1970s, over 2,000 public and private schools had implemented this new model (Swaab, 1974). Secondary school facilities were designed and built for modular scheduling. With its rapid adoption, as high as 15 % of all districts in the early 1970s, Wood (1970) stated, "Flexible scheduling is not a fad which will fade" (p. 42). However, the restructuring movement quickly lost momentum and the number of school districts using modular scheduling was down to 3% by 1981 (Tubbs & Beane, 1981). "By the 1980's the overwhelming majority of secondary schools had abandoned flex-mod scheduling" (MacIver, 1992, p. 1126). Why did modular scheduling fail? Table 2 provides a summary of research given for its demise.

Table 2. A summary of research on the failure of modular scheduling

Researcher and year	Reasons given for failure
Andren, 1978; Cavanagh, 1970; Cooper, 1985; Hicken, 1968; Speckhard & Bracht, 1968	Student abuse of time. Many students were not mature enough to handle the independent study time appropriately.
Dieterich, 1971	Lack of student accountability. Determining where a student should actually be and then holding him/her accountable was extremely difficult.
Goldman, 1983	Increase in minor discipline problems. Since the modules were as short as ten minutes, students were constantly in the hall.
Cavanagh, 1970; Cooper, 1985; Johnson, 1972	Inadequate resources. The facilities had to be compatible with the needs of the components of modular scheduling.
Dempsey & Traverso, 1983; Wilmoth & Ehn, 1970	Inflexibility of schedule. The large group instruction drove the other instructional components. If a teacher was absent or a speaker did not show up for large group instruction, the other instructional groups were paralyzed.
Hicken, 1968; Speckhard & Brandt, 1968	Lack of variety in lesson design and delivery in large and small group instruction. The delivery was primarily lecture in nature.
Albers, 1973; Brandt, 1968; Hicken, 1968; Speckhard & Swaab, 1974; Van Mondfrans, 1972	Negligible change in student achievement.
Andren, 1978	High cost of implementation and maintenance. Facilities had to be built or retrofitted to accommodate modular scheduling.
Cooper, 1985; Dieterich, 1971; Willmoth & Ehn, 1970	Lack of planning and staff development. In many cases teachers were not given the proper staff development to create the appropriate lesson design for the length of the components.

Middle school concept

One reform movement in the 1980s that did allow for restructuring of the school day was the transformation of a junior high school from operating under a "mini" high school philosophy to a middle school concept. The Carnegie Council's *Turning points* (1989) served as the blueprint for this reform movement. Teaming (schools within schools), interdisciplinary units, common core knowledge, adviser/advisee programs, ensuring student success, and participation by all are the building blocks of the middle school concept. The compelling reason for the conversion was to meet the unique academic, physical, emotional, and social needs of the early adolescent. The middle school philosophy is now accepted "best practice."

A byproduct of this movement was the availability of the middle school team to have a common set of students and common preparation times. Now it was possible for the team of teachers to meet regularly and plan how the curricular or interdisciplinary units were to be taught and to modify daily schedule to deliver the curriculum. This flexibility was the ultimate to align time with the curriculum, instead of the opposite.

Trying to replicate a variation of the middle school concept at the high school level has been difficult. The high number of electives and the tracking of students caused by sequential courses offered at the high schools have hindered the transformation. This lack of applicability could actually have a negative effect on the academic performance of first-year high school students. Rice (1997) examined the negative impact of the transition from middle to high school on student performance. He concluded that the greater the discontinuities (disruption in the continuity of the learning environments) that exist between the pre-high school and high school centers, the greater the decline of academic performance and the increase in the dropout rate.

The success on the middle school concept has been the impetus for a similar movement currently taking place at the high school level. The National Association of Secondary School Principals (NASSP) document, *Breaking Ranks* (NASSP, 1996), outlined sweeping reforms for high schools. Implementing their recommendations will help allow for a seamless transition between the middle school and the high school. A major component that aligns with the middle school philosophy is the better use of existing time available for teaching and learning.

Eight-period day

Whereas a six- or seven-period schedule was the norm through the 1970s (Kruse & Kruse, 1995), an eight-period daily schedule became popular in the 1980s. This occurrence was due in part to the "back to basics" reform movement (DeBoer, 1991). The philosophy of education was becoming more conservative, translating into a call for more required subjects, prolonged school year, an increase in homework, and better test scores (Cuban, 1990). Graduation requirements were increased in the core curriculum areas of language arts, mathematics, science, and social studies. To make room in the school day for required and elective courses the number of class periods offered needed to increase, resulting in a decrease in the length of each class period. Some high schools offer early-bird classes and may have the school day divided into as many as 10 periods.

Call for restructuring

The Carnegie Unit drove the system that equates learning with time in class and became the basis for the traditional schedule that controlled the behavior of teachers and students (Owens, 1995). Sizer (1984) found that this structure of the American high school hindered the teaching and learning process. In the *Breaking Ranks* report (NASSP, 1996), the task force argued, "the manner in which a high school organizes itself and the ways in which it uses time create a framework that affects almost everything about teaching and learning in the school" (p. 44).

The launching of the Sputnik was the wake-up call for American schools to reform and reform quickly. *A Nation at Risk*, a report by the National Education Commission on Excellence in Education (1983), revealed the crisis in the American school system and urged removal of time barriers. In *Action for Excellence*, the Task Force on Education and Economic Growth (1983) echoed the Commission's call to increase the length and intensity of students' academic learning time. The Education Council Act of 1991 established the National Education Commission on Time and Learning (NECTL). The Commission's report, *Prisoners of Time* (1994) pointed out five reasons for restructuring traditional school time paradigms:

- The fixed clock and calendar is a fundamental design flaw that must be changed.
- Academic time has been stolen to make room for a host of nonacademic activities.
- Today's school schedule must be modified to respond to the great changes that have reshaped American life outside school.
- Educators do not have the time they need to do their job properly.
- Mastering world-class standards will require more time for almost all students. (p. 13)

To initiate school reform successfully, the entire school framework needed restructuring (Sizer, 1984). Carroll (1994b) argued, "While it is possible to change without improving, it is impossible to improve without changing" (p. 108). He went on to say, "For nothing – absolutely nothing – has happened in education until it happens to a student" (p. 108). *Breaking Ranks* (NASSP, 1996) outlined sweeping reforms for high schools and served as a roadmap to implement them. One of the publication's "priorities for renewal" (p. 8) called for "restructuring space and time for a more flexible education" (p. 45). In this section, the authors recommended the following for revamping time in the high school structure:

- Each high school teacher involved in the instructional program on a full-time basis will be responsible for contact time with no more than 90 students during a given term so that the teacher can give greater attention to the needs of every student.
- High schools will develop flexible scheduling that allows for more varied uses of time in order to meet the requirements of the core curriculum.
- The Carnegie unit will be redefined or replaced so that high schools no longer equate seat time to learning. (p. 45)

Block Scheduling

Although modular scheduling failed in its attempt to restructure the secondary school day, it did pave the way for a new reform movement. In the early to mid 1960s, block scheduling arrived on the scene, although it did not begin to gain popularity in the United States until the 1980s. According to Van Mondfrans (1972), much of the credit for developing the block structure is given to Joseph Carroll, a former superintendent of schools in Massachusetts.

Just as with flexible modular scheduling, block scheduling addressed many of the same problems of a traditional schedule, yet avoided many of the pitfalls. Block scheduling sought to increase the length of an individual class period, thus reducing the number of classes a student attended each day and the total number of students a teacher instructed in a day.

Carroll (1990) called his block scheduling structure the "Copernican Plan" after the 16th-century astronomer, Nicolas Copernicus. Copernicus theorized that the sun, not the earth, was the center of the universe. At the time, his school of thought met with much resistance. The Copernican Plan challenged the long practice of structuring the secondary school day around the Carnegie unit. Its fundamental change "is a change in schedule" (Carroll, 1990, p. 358).

The Copernican Plan was "a solution looking for a problem" (Carroll, 1994b, p. 105). Carroll (1990) called his extended class structure "macro-structuring." In the Copernican model, a student is assigned to a minimum of two macro-classes per day for at least 90 minutes in length and up to four hours. Depending on the length of the block, the course would last 30 days, 45 days, 60 days, or 90 days.

Block scheduling evolved from the Copernican Plan. Variations of a block formatted structure currently being used today include a 4×4 block, an alternating day (A/B) block, a modified block (in which block classes are held one day and traditional classes the next), and other various hybrids that intertwine traditional-length classes, called "skinnies", with block-length classes (Wronkovich, 1998). Canady and Rettig (1995) indicated that although there are several types of block schedules, the two most popular configurations used throughout the United States are a 4×4 block and an alternating day block (A/B). From both a political and administrative standpoint, an A/B schedule is easier to implement than the 4×4 semester schedule (Canady & Rettig, 1999). Instructional flexibility is greater with a 4×4 schedule than the A/B format (Canady & Rettig).

The purpose of block scheduling is to provide a structure that benefits the student in the learning process. One way is to increase instructional time. In a traditional seven-period day, non-instructional activities such as passing time, taking and recording attendance, and reviewing the previous day's lesson can consume up to one hour of instruction time per day. The same non-learning time in a 4×4 or A/B block-scheduling model saves approximately 15 minutes per day. Over the course of the 180-day school year, these daily 15 minutes translate into 45 hours or roughly 6.5 instructional days (Whitfield, 1999).

Wronkovich (1998) posed the question of whether the block scheduling movement is another fad or a real reform. He concluded was that it has the potential to become real reform. A national survey conducted by Cawelti (1994) indicated that 38% of the nation's schools intended to implement block scheduling by 1995. Cawelti also listed block scheduling as one of his seven indicators of major school restructuring. The North Carolina Department of Public Instruction (1998) reported that two-thirds of North Carolina's high schools were using some form of block scheduling. The work of Canady and Rettig (1999) supported this premise of real reform movement by reporting that 30% of the nation's schools were using or considering some form of block scheduling. Francka and Lindsey (1995) also reported that 30% of schools have some form of block scheduling and that the number was growing at a rate of 10% a year. In Cornwell's (1997) survey of all 50 state Departments of Education (40 returned), he found only three states reported districts that had attempted some form of block scheduling and then discontinued it. This was in a total of seven districts out of an estimated 942 districts currently using block scheduling. Of the 201

Virginia schools that implemented a block schedule over the last nine years, only one has returned to a traditional schedule (Canady & Rettig, 1999).

Vawter (1999) identified 10 issues fostering the change to block scheduling:

1. Increased emphasis on technology.
2. Concern with the number of students not being served by the present educational system.
3. Various disruptions to the educational process.
4. Fragmented schedules and days.
5. Falling student test scores.
6. Impersonal nature of school.
7. Need to address different learning styles and learning rates of students.
8. Need for longer times for different teaching strategies.
9. Need to reduce the unwise use of available time.
10. Growing trend of school boards and state government to add more requirements to graduation.

Benefits of block scheduling

High schools converting from a traditional schedule to a block schedule offer many potential benefits to students and staff. Sergiovanni and Starrett (1993) defined school climate as, "the enduring characteristics that describe the psychological character of a particular school, distinguish it from other schools and influence behavior of teachers and students" (p. 82). Currently, the literature on block scheduling strongly supports the premise that block scheduling improves school climate (Canady & Rettig, 1995, 1999; Hartzell, 1999; Queen & Gaskey, 1997; Shortt & Thayer, 1999; Vawter, 1999). Operating under a block schedule benefits students, teachers, and administrators. Evidence shows that students' attitude toward school improved under all major forms of block scheduling (Averett, 1994; Kramer, 1997a). School districts can also expect to see increased student attendance (Vawter, 1999). Both the school climate and the learning environment in the classroom improve as students and teachers spend more concentrated time with one another (Hartzell, 1999).

Block scheduling reduces the number of classes students must attend and prepare for each day and/or semester (Canady & Rettig, 1995; NCDPI, 1998). In a 4×4 or A/B block structure, a student typically would enroll in three classes per day, with learning spread out over 90 minutes. He/she would have to concentrate on, at most, four classes per day. Since students are not rushing from class to class, block schedules provide a relaxed environment that is more conducive to learning (Hartzell, 1999).

In a 4×4 block structure, students could take two sequential curricular courses in one school year, such as Algebra I and Algebra II, Spanish I and Spanish II and thus accelerate through a curriculum area (Canady & Rettig, 1995). Students also could repeat a failed course during one academic school year (Canady &Rettig; NCDPI, 1998).

Likewise, teachers benefit from a block structure because of the decrease in the number of students they will see and the number of courses for which they will prepare and teach in a given day (Canady & Rettig, 1995; Cawelti, 1994). It is recommended that a teacher teach three out of four blocks per day. Assuming there are 25 students per class, in a 4×4 or A/B block schedule a teacher would be responsible for only 75 students per day (NASSP, 1996). This results in less paperwork during the course of the week (Hampton, 1997). Fewer classes equates to a decrease in the number of schedule changes (Cawelti, 1994). Consequently, teachers have the potential to develop closer relationships with their students and to give them additional time for help (Cawelti).

Strong evidence exists that those schools using a block schedule experience fewer incidences of student discipline infractions and tardiness (Canady & Rettig, 1995, 1999; Cawelti, 1994; Hackmann, 1995; Queen & Gaskey, 1997; Shortt & Thayer, 1999; Vawter, 1999). One major factor that contributes to this reduction is that with any type of block scheduling the number of passing times between classes decreases, creating fewer opportunities for students to engage in inappropriate behavior (Festavan, 1996; Francka & Lindsey, 1995). Canady and Rettig (1999) reported in their empirical study of the advantages of block scheduling that there is evidence the number of discipline referrals in schools using a block structure is reduced by 25-35% and that there is a significant decline in the number of suspensions.

In a 4×4 or A/B block schedule, a student potentially can sign up for eight yearlong courses, equivalent to an eight-period day. If a school uses a six- or seven-period schedule and switches to a block format, the school can increase its course offerings from 14 to 33%. Students often complete more courses in their high school career under a block schedule (Edwards, 1995; NCDPI, 1998;Williams, 1985) and these classes include more core, advanced, and advanced placement classes.

Sharman (1990) investigated the relationship between dropout rates and secondary school scheduling patterns. His study revealed that schools on a block schedule appear to have lower dropout rates than schools on a traditional schedule.

Joseph Carroll (1994b) insists that the Copernican Plan is not about block scheduling, but rather the relationship between time and learning. John Carroll (1963) developed the following model to explain this relationship:

$$\text{Degree of Learning} = \frac{\text{Time Spent Learning}}{\text{Time Needed to Learn}}$$

According to this formula, if a student spends 30 minutes learning how to spell 40 new vocabulary words and he/she needs 30 minutes to master the task, then 100% learning will take place. On the other hand, if the student needed 45 minutes to master the task, only 75%

learning could take place. Thus, block scheduling affords a student the chance of a higher "degree of learning."

The main benefit of block scheduling is its ability to offer extended periods of time. If used properly, it allows students variable amounts of time for learning without lowering standards and without punishing those who need more or less time to learn. There would be less time needed for lab set up, more time available for group work, and fewer time-on-task minutes lost at the beginning or end of the class period. In a longer class period there are more opportunities for teachers to use a variety of teaching methods and strategies (Cawelti, 1994; Vawter, 1999). It can provide teachers with blocks of teaching time that allow and encourage the use of active teaching strategies and increase student involvement (Canady & Rettig, 1995). More time can be devoted to project work and for team and interdisciplinary teaching (Hampton, 1997). Block scheduling provides the structure that allows for the creation of a rich learning environment and a constructivist classroom.

Constructivist classrooms

Boyer (1983) argues more time for instruction is not as important as the need for better use of existing time. There is no point in adding more time to the school day, if it is going to be used in the same way (NECTL, 1994): "Both learners and teachers need more time – not to do more of the same, but to use all time in new, different, and better ways. The key to liberating learning lies in unlocking time" (p. 10). When high school students are scheduled into classes by subject and for short periods of time, memorization and not conceptualization takes place (Goodlad, 1983). Canady & Rettig (1999) concur by saying, "merely changing the school bell schedule will not guarantee better student performance" (p. 15).

In Insley's (1999) study on the relationship of teaching practices to student achievement, she identified three premises that call for a change in teaching pedagogy needed for the 21st century:

1. The information explosion of the 1970s and the subsequent technological resources available to many make it impossible to teach students all of the information available in any one content area.
2. Given the impossibility of knowing everything that can be known in any given subject, education must teach students the skills to access resources, to create and to solve problems, and to master the critical thinking process involved in selecting, organizing, and using information.
3. Given the complex issues students will be called on to deal with in today's diverse society, teachers need to change their focus from teacher-driven curriculum, rules, and procedures to other practices which place the student in the center of learning, breaking open the learning process for all students while engaging them in critical content areas. Using this approach will prepare students to resolve the societal conflicts, which are a part of living in diverse communities. (pp. 7-8)

Block scheduling can provide the time-structure reform needed to accommodate this changing paradigm and to better utilize the finite time that exists in a school day.

According to Carroll (1994b), the two main advantages of the Copernican Plan are the ability to: (1) improve relationships between teachers and students; and (2) make the workload of students and teachers more manageable. Canady and Rettig (1996) took a different slant on the power of block scheduling and how it relates to time. They strongly contended that the single most important factor to determine whether block scheduling will be a success or failure is the extent in which teachers alter their lesson design and teaching strategies to take advantage of the extended time afforded by the block schedule.

When converting to block scheduling, teachers may try to fit two lessons into one extended class. However, they soon learn that their approach to learning and teaching method must change (Hackmann & Schmitt, 1997): "Concepts and activities must be reorganized within the new time frame" (p. 2). The traditional school structure emphasizes coverage rather than reflection, discussion, and thoughtful analysis. Short and Thayer (1995) suggested that planning lesson design under a block format requires teachers to think differently about teaching. They asserted, "Block scheduling permitted greater amounts of time for student learning, laboratory work, and student directed interactive activities" (p. 75).

Hackmann (1999b) focused on the potential of using the extended blocks to create a constructivist classroom environment, where the learning emerges in the mind of the student from the real-world activities taking place in the classroom. Confrey (1990) defined constructivism as the "belief that all knowledge is necessarily a product of our own cognitive acts" (p. 107). The teacher in this model is a resource for learners and refrains from "telling." The goal of the instructor is to develop the necessary lesson design and provide the resources for the learning to emerge. Significant research shows when students are actively engaged in their own learning, better retention, understanding, and active use of knowledge will result (Perkins, 1999). Glatthorn (1995) outlined the five principles of constructivism:

1. The learner is actively engaged in making meaning.
2. Learning is socially constructed, allowing learners to interact with one another.
3. Knowledge becomes generative as it is applied in context-based and meaningful problems.
4. The most effective learning results in conceptual change.
5. Optimal learning involves metacognition–reflecting on one's learning throughout the process. (p. 275)

Phillips (1995) identified the three roles in constructivism: the active learner, the social learner, and the creative learner. Active learners seek and acquire the knowledge and understanding. They discuss, debate, hypothesize, investigate, and form viewpoints, as opposed to just listening, reading, and working through exercises. The social learner does not work or learn in isolation. The constructivist understands that knowledge and understanding come from dialogue with others. In a constructivist classroom, learners will create or recreate knowledge for themselves (Perkins, 1999). Real learning takes place if the student can reconstruct the knowledge.

Grennon Brooks and Brooks (1993) perceived that at the very heart of constructivism lies the simple truth that "learners control their learning" (p. 21) and that students construct their own understanding of the world in which they live. They contended it is human nature to do so. Their work identified five central tenets of constructivism:

1. Constructivist teachers seek and value students' point of view.
2. Constructivist teachers structure lessons to challenge students' suppositions.
3. Constructivist teachers recognize that students must attach relevance to the curriculum.
4. Constructivist teachers structure lessons around big ideas, not small bits of information.
5. Constructivist teachers assess student learning in the context of daily classroom investigations, not as separate events. (p. 21)

Reinforcing the beliefs of Piaget and other developmental theorists, Fosnot (1996) stated that, "Learning is not discovering more, but interpreting through a different scheme or structure" (p. 16). Understanding the concepts of constructivism helps differentiate between learning and performance. Katz (1985) emphasized that focusing on performance usually results in short-term recall of concepts, while focusing on learning generates long-term understanding.

When creating a constructivist classroom, Insley (1999) summarized:

> Constructivism requires the teacher to be a reflexive practitioner. The teacher's role has changed to one of making keen observations, guessing and following hunches about how to create a proper setting for students to construct knowledge for themselves. Reflective teachers refrain from giving answers directly. Often times they will use questions or prompts that encourage further thought and exploration based on intuition about students' internal states. Equally important is the learning environment in the classroom, and the teacher's characteristics, beliefs, and assumptions are a part of the learning environment. Thus, learning not only depends on the information the teacher imparts, but also on how the teacher interacts with the students. (p. 28)

Canady and Rettig (1996) wrote, "If instructional practices do not change, the block scheduling movement of the 1990s, like the flexible modular scheduling movement of the 1960s and 1970s, will be buried in the graveyard of failed educational innovations" (p. 45). Will teachers take advantage of the opportunity to create a constructivist classroom under a block format? The number of positive answers to the question is directly proportional to the amount of staff development that precedes the implementation of block scheduling, and the level of administrative expectations that will hold teachers accountable for creating a constructivist environment. One thing is for certain: it is nearly impossible for constructivism to take place in a traditionally scheduled school.

Disadvantages of block scheduling

The radical changes caused by block scheduling raise many concerns. Most of these deal with the schedule's impact on student retention and on curriculum and instruction (Hartzell, 1999). The intent of this section is to state the perceived drawbacks of block scheduling and counter when possible with one or more solutions.

Critics contend that retention of material is less in block classes as opposed to traditional yearlong class, especially in a 4×4 format (Bateson, 1990; Carroll, 1994). This retention gap appears to lessen as time goes on. Canady and Rettig (1995) presented evidence that teachers could note very little difference between the retention of students who had recently completed a prerequisite course and that of other students with greater time lapses between courses. Overall, a gap in instruction initially may reduce recall of recently learned material but it has not been shown that it has any long-term negative effects on student learning (Kramer, 1997a).

Opponents argue that the same amount of material cannot be covered in a 4×4 block semester course as opposed to a yearlong course (Rettig & Canady, 1996). Advocates admit that teachers may not be able to cover the same amount of content in the given amount of time, but they counter by saying that the block structure allows students to be more engaged and the learning has more meaning, thus increasing student retention. This approach will reduce the amount of review time necessary and will negate some of the lost time (Schoenstein, 1994). Hackmann's (1999b) constructivist views support the notion that "less is more." Changing to block scheduling ideally forces reform in teaching pedagogy and curriculum alignment. The current "standards and benchmarks" movement parallels with the rise in number of high schools implementing some form of block scheduling. To effectively use a "block," it is imperative that teachers understand what is the nonnegotiable curriculum and the difference between "need to know" and "nice to know" components of a well-articulated course of study.

Critics ask how the gaps in time for sequential courses, such as foreign language, or advanced placement (AP) classes taken in the fall, when the AP test is taken in the spring, or non-academic offerings, such as band, are handled to avoid a decrease in student performance (Edwards, 1995). Proponents reiterate that if the learning is embedded and can be created by the student, the retention of knowledge will transcend these gaps. Some schools offer "skinnies" (one-half blocks) for music, foreign language, and AP courses. If students are offered the opportunity to take these classes in a block format, they actually can accelerate in sequential courses. For example, they could complete two years of foreign language in a year's time.

Students who transfer into the school may be at a disadvantage if they are coming from a traditionally scheduled school (Canady & Rettig, 1995). What magnifies the problem is the variety in course offerings and variations in scope and sequence at different high schools (Shortt & Thayer, 1995). This effect may be offset since the new student would be enrolled fewer courses and thus could get caught up with the rest of the class more rapidly. One suggestion is to have an advancement center for transfer or high absentee students to receive intensive training on core subjects, if they get behind (Averett, 1994; Canady & Rettig, 1995).

When a student or teacher is absent the effect potentially will be doubled with block scheduling (Schoenstein, 1994). Teachers need to leave detailed lesson plans in the event of their absence. Peers could be assigned to mentor returning students after an absence. Again, the negative effects will be minimized due to the fact that students will be taking and teachers will be teaching an average of three classes per day.

Bowman (1998) asked the rhetorical question, "If block scheduling is the answer, what is the question" (p. 244)? He answered by throwing up a caution flag:

> If it turns out that the question is 'What is the best way to improve instruction to meet the changing needs of today's youth?' Then one hopes that educators would be cautious in reconfiguring the education of tens of thousands of students in hundreds of communities in the absence of data that shows that block scheduling produces significantly better results than the system that it

> replaces. For as Santayana has noted compellingly, 'Those who do not remember the past are condemned to relive it.' (p. 244)

Schools can increase the odds for the successful implementation and reduce the number of disadvantages of block schedules by including key elements into their conversion process.

Elements needed for implementing a block schedule

Most often, the successful transformation to a block schedule depends on the degree in which certain key elements are implemented before, during, and after the schedule change (Vawter, 1999). Perreault and Isaacson (1996) stated, "The process used by a school to decide on and to implement a new schedule is at least as important as the type of schedule itself" (p. 265). In order for a change to occur, block scheduling must be identified as a solution to a perceived problem in an existing time structure (Anderson, Brozynski, & Lett, 1996; Hackmann, 1995). Change takes time. A minimum of a year for planning and implementing the conversion and three years to evaluate the change in structure is needed (Anderson, et al., 1996). The length of time required is dependent on the current level of effectiveness of the staff. Teachers already progressive in their teaching strategies and who possess a desire to improve will need less time to implement a new schedule (Hackmann, 1995).

All stakeholders (community, parents, faculty, school board, administration, and students) must be included in the decision-making process and be allowed to give input (Anderson et al., 1996; Canady & Rettig, 1999; Cunningham & Nogle 1996; Furman & McKenna, 1995; Hackmann, 1995; Perreault & Isaacson, 1996). It is critical to gather data from outside sources such as current literature review, related conferences, action research, and college and university personnel (Hackmann, 1995).

A certain level of internal and external conflicts and resistance can be expected to develop. These will be specific for each school implementing the conversion. Convictions must be strong to weather these storms. A needs assessment should be done on a school-by-school basis. Schools that successfully implement a block schedule identify their strengths and weaknesses and basic assumptions begin from those perspectives (Perreault & Isaacson, 1996). Potential barriers will be identified and a case built to overcome these objections.

Teachers must clearly understand the concept of block scheduling and be able to explain and model the new approaches needed to implement the necessary changes it requires (Hartzell, 1999). Staff will need to cultivate a systems thinking approach to determine what impact the adoption of the new schedule will have on the entire district (Hackmann, 1995).

During the process, it is a time for the building principal to demonstrate his/her quality of being an educational leader. Principals will need to foster a climate that encourages staff to take risks and try new teaching strategies. Their ability to effectively communicate and problem solve is especially critical (Hartzell, 1999).

A change in schedule for a high school does not guarantee an improvement in educational process (Perreault & Isaacson, 1996). Block scheduling provides the vehicle for successful reform to take place (Shortt &Thayer, 1995), but longer time blocks cannot succeed without adequate planning time, curricular restructuring, and adequate administrative support (Kramer, 1997b). Time and resources must be found to offer staff development training for teachers (Cunningham & Nogle, 1996; Furman & McKenna, 1995; Shortt &Thayer, 1995). Course content, class presentations, and student-teacher relationships will change under a block format (Perreault & Isaacson, 1996). Teachers must develop strategies to utilize a 90-minute block and time must be found to develop lesson designs accordingly (Cunningham & Nogle, 1996). Standards and benchmarks may need to be reworked to identify the "need to know" and "nice to know" elements. Faculty will need to be trained in the areas of cooperative learning, thinking skills, interdisciplinary teaching, alternative assessment, planning, and the infusion of technology (Shortt & Thayer, 1995). The "one-shot" exposure approach will not work. Staff development must be on-going to allow for reinforcement, staff turnover, and mid course corrections (Perreault & Isaacson, 1996).

An evaluation process must be developed and success indicators must be established beforehand (Anderson, et al., 1996; Hackmann, 1995). Data must be collected in the areas of student achievement, discipline, school climate, and student/staff/community satisfaction to help evaluate the success and impact of block scheduling. When successes occur, they must be celebrated and communicated throughout the educational community (Hackmann, 1995).

Standardized testing

The current study used the Iowa Test of Education Development (ITED) as the norm-referenced standardized instrument to compare the school using different scheduling methodology. This review of literature would be remiss if it did not include a discussion of standardized tests.

High schools administer standardized tests, hoping the resulting data will help teachers improve instruction and student performance (Jones, 1997). "Policymakers, business leaders, school boards, and parents want accountability, proof that their investment in education produces higher levels of achievement for students" (Archbald, 1988, p. v). With the standards and benchmarks movement in place throughout the nation and the scrutiny that public schools are under by stakeholders, standardized testing in high schools is a high-stakes proposition (Jones, 1997).

Jones (1997) stated that there are several positive reasons for schools to administer standardized tests. Administering the instrument requires little time. Machine scoring produces quick feedback, and the tests are relatively inexpensive to implement. Test results can disaggregate data to help identify the "holes" in the curriculum that need greater emphasis. The disaggregated data also can monitor how well the curriculum is being taught to diverse populations. Test results can help answer the questions of whether the curriculum is being mastered by all students with regard to gender, race, socio-economic status, and ability groups (Jones).

Data collected from standardized testing have limitations. The "multiple choice" format asks students to select a correct answer, not produce a correct one. Hymes (1991) suggested that standardized testing may measure a student's ability to memorize facts or trivialize knowledge but does not demonstrate application of skills, conceptualization of knowledge, or higher order thinking skills. He surmises that teaching has advanced ahead of testing. Worthen and Spandel (1991) summarized the most common criticisms of standardized testing:

1. Standardized achievement tests do not promote student learning.
2. Standardized achievement and aptitude tests are poor predictors of individual students' performance.
3. The content of standardized achievement test is often mismatched with the content emphasized in a school's curriculum and classrooms.
4. Standardized tests dictate or restrict what is taught.
5. Standardized achievement and aptitude tests categorize and label students in ways that cause damage to individuals.

6. Standardized achievement and aptitude measures are racially, culturally, and socially biased.
7. Standardized achievement and aptitude tests measure only limited and superficial student knowledge and behaviors. (p. 69)

Are norm-referenced standardized tests an accurate indicator of student learning, and should they be used to compare student performance between different students, buildings, districts, and states? The fact is schools need some type of educational data to provide accountability to the public. The value of standardized testing for this purpose is a highly debated issue in the educational community.

Jones (1997) emphasized when students take standardized tests, their attitude toward such tests is important. If students, parents, and teachers disagree on the purpose or worth of taking standardized test, the results on the tests may suffer. It is essential that all stakeholders share the common belief that standardized tests are useful.

Although alternative forms of testing – performance based and authentic – have become popular in the 1990s, schools still rely on norm-referenced standardized testing to take a snapshot of student achievement. Most states have adopted legislation mandating some form of standardized test be given at least annually to hold schools accountable for student academic growth. Jones (1997) contended that standardized norm-referenced tests have secured a place in the educational community for the following reasons:

1. Student placement or school readiness.
2. Measuring mastery of learned objectives.
3. Student comparisons at local, state, and national levels.
4. Class comparisons within schools.
5. School comparisons with other schools in a district, state, and nation.
6. Geographic comparisons of students in other states.
7. Curriculum monitoring.
8. Predictability of college success.
9. Sorting students for many reasons.
10. Helping improve student instruction. (p. 26)

Morris (1997) summed up the standardized test dilemma, "What must be realized, as many researchers have already discovered, is that public attention toward achievement in the nation's schools is directed at the results of standardized testing programs" (p. 37). To reeducate the media, government entities, parents, and other stakeholders to think otherwise would be a major paradigm shift.

Related research involving standardized testing

Studies comparing traditional scheduling and block scheduling for high schools have yielded mixed results. The current literature consists primarily of personal stories, self-reports, and anecdotal evidence on the advantages of block scheduling. Many of these studies support the notion that student grade-point averages will improve with a block format (Canady & Rettig, 1999, Edwards, 1995; Hampton, 1997; Sharman, 1990). Relatively few relevant quanitative studies exist (Vawter, 1999). This portion of the review focuses on a comparison of academic achievement on standardized tests between block and traditional scheduled schools.

Bateson (1990) compared the science achievement scores on the British Columbia Science Assessment instrument of over 30,000 Canadian 10th grade students. The focus of Bateson's study was to investigate the impact of different timetable patterns on science attitudes and science achievement. The cognitive scores of students enrolled in yearlong science courses were significantly higher than the scores of students in blocked semester courses. Students enrolled in second semester science classes also outperformed students in the first semester classes. Bateson surmised that differences among the semester groups are due to the varying degrees of retention. Although the cognitive performance significantly favored the yearlong courses, this study also found no significant differences among any of the groups on the affective scales. In other words, the type of schedule did not significantly affect the students' attitude toward science. The students enrolled in the semester courses' affective domain scores were actually slightly higher.

In 1995 Bateson's study was replicated and expanded to include mathematics (Marshall, Taylor, Bateson, & Bridgen, 1995). 10th grade students' scores on the British Columbia Mathematics and Science Assessment confirmed Bateson's (1990) results that all-year students outperformed semester students. Kramer (1997b) contended that reduced math scores in these and other Canadian studies were attributed to irregular planning time, little opportunity to modify curriculum, and the provincial examination system.

Many studies conducted in the United States have contradicted the Canadian studies. On a survey of block scheduling carried out by the Virginia Department of Education, only 1% of the responding teachers and 5% of the responding administrators reported that block scheduling has a negative effect on student standardized test scores (Shortt & Thayer, 1999). Analysis of student scores on the Virginian State Assessment Program by Shortt and Thayer (1999) indicated that both reading gains and mathematics gains were higher for students in schools on either an A/B alternating or 4×4 block schedules, when compared with schools on a traditional schedule.

Morris (1997) investigated the effects of block scheduling on 10^{th} grade students in six public high schools with enrollments from 1,600 to 2,700. He found that the passing rate of 10th grade students for reading and mathematics who took the Texas Assessment of Academic Skills (TAAS) in block schools was significantly higher than the passing rate for students on a traditional schedule. TAAS is a criterion-referenced standardized test that measures minimum competencies in mathematics, reading, and writing. Statistics for passing rates under the traditional schedule were gathered three years preceding implementation of a block format. Morris concluded some of the gain may be attributed to the abundance of pressure put on school districts by the state to increase student performance on the TAAS.

In another study involving TAAS, York (1997) compared the 10th grade mathematics, reading, and writing scores of students in Texas high schools operating on block schedules with the same scores of 10th grade students on traditional schedules. His analyses of covariance supported the hypothesis that there were no statistically significant differences between mathematics, reading, and writing achievement of tenth grade students operating in a block versus non-block schedule. The results also supported the same conclusion for students coming from lower socio-economic backgrounds.

Veal and Schreiber (1999) compared traditional and block scheduled 10th grade students' performance on the Indiana Statewide Testing for Educational Progress (ISTEP+). During their freshman year, the students in one high school were randomly assigned to a block or traditional schedule. The 327 participating students were tested in the areas of reading, language, and mathematics. The test results indicated no significant difference in the performance of the students in reading and language areas. Traditional scheduled students scored significantly higher on mathematics computation than block scheduled students. This was the first year that the studied school used a block format.

Hamdy (1996) compared four sets of standardized test scores from Florida students attending two block schools and two traditional scheduled schools. The assessment instruments used for comparison were the Comprehensive Test of Basic Skills (CTBS) for 9th grade students, Grade Ten Assessment Test (GTAT) and *Florida Writes!* (FW) for 10th grade students, and High School Competency Test (HSCT) for 11th grade students. Approximately 2000 students took each of the four tests, for a total of 8,000 participants. One of the block schools used a 4×4 schedule and the other utilized an A/B block schedule. Results indicated that there was a significant difference between the traditional and block schools with respect to standardized tests. The traditional schools significantly outperformed the block schools on three of the four tests. There was no significant difference in performance on the GTAT. The comparison between the 4×4 block school and A/B block school indicated that there was no significant difference in CTBS, GTAT, and HSCT scores. The A/B scheduled school outperformed the 4×4 on the *Florida Writes!* test. These comparisons were made during the 1995-1996 school year. This was the first year of implementation of a block format in the two schools.

Whitfield's (1999) study examined the difference in academic performance of students on an A/B block schedule and students in the same school on a traditional seven-period schedule. Performance indicators were mean scores on the Tests of Achievement and Proficiency (TAP) and senior grade point averages. TAP are the secondary level of the Iowa Tests of Basic Skills. This two-year study consisted of 417 students and disaggregated data by gender and ability level. Whitfield concluded that there was no significant difference in academic performance between the two scheduling methodologies as measured by TAP scores and senior year grade point average. A major limitation of the study was the fact that the implementation year was compared to the preceding year.

Williams (2000) found mixed results in his study that compared the scores on the Stanford Achievement Test (SAT) of 256 students in four rural schools that were using a traditional schedule during the 1997-1998 school year, and the SAT scores from the same students in the same schools that had converted to a 4×4 block schedule during the 1998-1999 school year. Scores of 9^{th} and 10^{th} grade students on a traditional schedule were compared to their 10^{th} and 11^{th} grade scores the following year on a block schedule. SAT composite scores of these eight groups targeted revealed that three groups preformed higher, two remained the same, and three declined. SAT scores increased in the curriculum areas of social science and language in six of the eight groups compared, reading scores increased in five, science scores increased in three, and math scores increased in only two of the eight groups.

The largest U.S. study in this area was conducted by the Department of Instruction in North Carolina (Canady & Rettig, 1999). This study indicated that in the majority of the statistical comparisons there was no significant difference in the End-of-Course (EOC) test scores between students in schools using either a block or non-block schedule. The EOC is a norm-referenced standardized test used to measure student academic growth in North Carolina. EOC scores in block schools were significantly higher in the curriculum areas of English, biology, and U.S. History.

Vawter (1999) found that schools that have successfully implemented block scheduling could expect increases in one or more areas of academic achievement. The most significant is in the increased number of students on the honor roll and a reduction in student failures. Smaller positive gains can be expected in standardized test scores (SAT/ACT/AP). Rarely were these tests affected negatively. While the changes were consistent across the different types of block schedules, the 4×4 block schedule had the most positive impact on academic achievement. Interestingly, the type, location, and size of school or the make-up of the student population had little or no impact on most of the changes.

The summary of this review of literature on academic performance, when measured by standardized test scores, would indicate that there is no significant difference between block and traditionally scheduled schools or between 4×4 and A/B block schools.

A/B versus 4×4 block

Deciding between implementing an A/B or a 4×4 block schedule should be based on the unique needs of each individual school, since both have advantages and disadvantages. From both a political and administrative standpoint, an A/B schedule is easier to implement than the 4×4 semester schedule (Canady & Rettig, 1999). This is due in part to the fact that adopting an A/B block schedule is less of a paradigm shift for all stakeholders. It is easier to convert from an 8-period day traditional schedule to an 8-period every-other-day schedule.

Either schedule affords the benefits of students and teachers taking or teaching only one-half as many classes per day. School climate issues are similar. One advantage of a 4×4 schedule is that the number of classes for which a student has to prepare and a teacher is responsible during a given term is one-half that of an A/B schedule. Since semester courses meet all year long, an A/B schedule lowers the level of concern when addressing retention issues. A 4×4 schedule allows students to double-up and take back-to-back sequential courses and/or retake failed courses in one year (Canady & Rettig, 1999). Studies indicate that schools are more likely to convert from an A/B schedule to a 4×4 schedule than they are to switch from a 4×4 schedule to an A/B schedule (Canady & Rettig).

Lack of convincing evidence

To block or not to block is a decision many schools are contemplating. Sommerfeld (1996) found in a review of literature related to studies measuring the impact of block scheduling, that standardized tests scores have increased, declined, or stayed the same. Anecdotal and case study evidence dominates the current literature. There is a lack of hard research measuring student outcomes (Canady & Rettig, 1995; Edwards, 1995). To make informed decisions as to whether to implement block scheduling, teachers, administrators, parents, and school boards need to know the effect that this schedule change has upon students, teachers, and schools (Vawter, 1999)

Stanley and Gifford's (1998) review of literature on 4×4 block scheduling concluded that hard quantitative evidence to support or disprove claims of increased efficiency of schools with block scheduling is sparse. Case studies and subjective evaluations are the most common, as opposed to empirical support. Stanley and Gifford (1998) noted the studies that have been broader in nature or use a statistical approach are weakened by the lack of duration of time the schools have used block scheduling.

Veal and Schreiber (1999) indicated that most studies have examined students after they have switched to a new schedule. Few studies have compared student achievement within the same school utilizing different schedules. The current study examined the same school before implementation of block scheduling and again at least two years after implementation.

Bowman (1998) argued, "empirical verification for the alleged effectiveness of block scheduling is meager and conflicting" (p. 1). Sadowski (1996) observed that, "systematic research on the effectiveness of block scheduling is scarce" (p. 2).

Vawter (1999) made the following conclusions from his comprehensive literature review and summary of essential research:

1. The available statistical studies are few, often contradictory, and limited in scope and content.
2. Most of the available literature is of nonstatistical and uncontrolled reports.
3. The trends in the literature point to some common areas that need to be researched. (p. 88)

He found from his extensive view of literature that the majority of references are narratives, case studies, or summative articles that disseminate information. Only 10% were part of a dissertation or an evaluation that used descriptive statistics. Twenty-three percent of his references used some form of descriptive statistics, of which most were frequency counts rather than comparisons of pre-post data in a statistical analysis (Vawter).

Summary

This extensive review of literature has outlined the historical development of time structures used in secondary schools. It started with the origin of the Carnegie unit, nearly a century ago, as a way to standardize high school instruction and invite the use of a traditional six- or seven-period day. Flexible modular scheduling was one unsuccessful reform movement in the 1960s and 1970s that tried to break the cycle of fixed time schedule. With the adoption of the middle school concept, a junior high school could escape becoming a "mini" high school and afford teachers the opportunity to vary and align the amount of time needed to deliver the curriculum. The eight-period day evolved from the "back to basics" reform movement.

The launching of the Sputnik put an emphasis and a spotlight on the American educational process. National reports, such as *A Nation at Risk* and *Action for Excellence*, called for an increase in the rigor of the American school and challenged them to find ways to maximize the use of existing time. This review supports the notion that scheduling methodology affects the educational process (Whitfield, 1999).

Although modular scheduling did not succeed in becoming lasting reform, it did pave the way for the block scheduling movement, which is currently gaining popularity throughout the United States. Joseph Carroll is given credit for the extended block-of-time configuration called the "Copernican Plan." Today's 4×4 and alternating block schedules evolved from Carroll's "macro-structuring" concept. Some reports indicated that as many as 50% of the nation's schools are using or considering some form of block scheduling.

Current literature supports the notion that block scheduling improves school climate, reduces the number of discipline referrals, reduces the number of courses a teacher teaches and a student attends in a given day, and gives students the opportunity to accelerate through sequential courses or repeat a failed course. Block scheduling allows for the creation of a constructivist classroom. In a constructivist environment, learning emerges in the mind of the student from the real-world activities taking place in the classroom. Since learning is constructed from the student's own framework of personal experience, it will not easily be forgotten.

Some of the perceived drawbacks that critics contend weaken the rationale to implement block scheduling include: a potential decrease in retention rates, the loss of some curriculum, and the jury being "out" with respect to student achievement.

When the decision is made by a district to implement block scheduling, the conversion process should include the following elements: collection of research and information from multiple sources, input from all stakeholders, ongoing staff development, time for planning and implementation, identifying barriers, strong instructional leadership, and an evaluation process.

The appropriate uses of a standardized test were discussed. Benefits and pitfalls were spelled out. The debate continues over the question of whether standardized tests are an accurate indicator of student learning. Currently, most publics expect schools to report standardized test scores as a means to compare the academic performance of students, schools, districts, and states.

The research is mixed when it comes to gains in student academic performance that is associated with block scheduling. The consensus is that grade point averages of block-scheduled students will be higher than those traditionally scheduled. The majority of American studies, involving norm-referenced standardized tests, that were reviewed, indicated there is no significant difference in student performance between students scheduled in a traditional setting and those scheduled in a block format. Most of these studies have been case studies involving only a few schools and/or were conducted on schools one or two years after implementing block scheduling.

This review of literature supported Hackmann's (in press) conclusion, "although the block-scheduling literature base is growing, much of the data tends to consist of anecdotal case studies or studies related to building climate" (p. 10). Even if student performance does not improve significantly, the literature overwhelmingly supports the conversion of schools from a traditional to block format to take advantage of the other benefits it affords.

CHAPTER III. METHODOLOGY

Introduction

The purpose of the study was to determine whether scheduling interventions have an effect on student achievement. The study sought to ascertain whether schools using different scheduling models have different scores on the Iowa Tests of Educational Development (ITED). The study compared performance, as measured by ITED scores, of 4×4 block-scheduled schools, A/B alternating-day block-scheduled schools, 8-period day scheduled schools, and Iowa norms. The battery of ITED scores used for comparison included reading, mathematics, science, social studies, and composite scores. Specifically, this chapter describes the research design, sample, population, null hypothesis statements, instrument, and data collection and analysis procedures.

Research Design

This research project was designed as a causal-comparative study. Five of the hypotheses were tested by comparing F-values from a series of two-tailed tests using analysis of covariance (ANCOVA) as the analytical procedure. Two were tested using a simple t-test. The standard for significance was set at the α=.05 level. The unit of analysis was the mean scores of 11th grade students in a particular school. The performance on the ITED was the dependent variable. The different groups of students using the various types of schedules and students' gender were the main effects in the model. Size of school was the covariate that was controlled.

Human Subjects Release

Prior to conducting the study, it was reviewed and approved by the Iowa State University Committee on the Use of Human Subjects in Research. The committee concluded that the rights and welfare of the human subjects were adequately protected and that the potential benefits and expected value of the knowledge sought outweighed any risks. They also concluded that confidentiality of the data was assured.

Sample and Population

Independent samples for the current study were selected from three of the scheduling types identified by Hackmann (1999b) in the population of all Iowa high schools. The first sample was a subset of the schools using a 4×4 block schedule. One parameter used in the selection process was the year of implementation of the 4×4 block schedule. This subset of schools converted to a block schedule on or before the year 1997. Another parameter was the schools that administered the ITED to their 11th grade students in the fall of their pre-implementation year and again in the fall of 1999. Therefore, the 11th grade students included in the study were on a block schedule in excess of two years and for the entirety of their high school experience. This was done to minimize the effect of the amount of staff development provided to the teachers that preceded the conversion to a 4×4 schedule. It also provided a longevity component to the study. This same process was repeated to select a sample of A/B block scheduled schools for the study. Schools in this study had adopted a block schedule anywhere in a range of years between 1994 and 1997. Table 3 indicates the year the Iowa high schools included in the sample converted to a block

Table 3. Implementation year of block schools

Implementation year	Block schedule type		Total
	4×4	A/B	
1994	0	3	3
1995	4	5	9
1996	7	11	18
1997	4	10	14
Total	15	29	44

schedule. A random sample of schools using an 8-period day schedule was selected from a total population of schools that had utilized an 8-period day since 1993. Fifteen 4×4 block, 29 A/B block, and 38 8-period day schools met the criteria for inclusion in the study. Table 4 summarizes how the total population was narrowed down by the above criteria to obtain the sample of Iowa high schools used in the study.

The number of 11th grade students taking the ITED in the 4×4 block schools ranged from 18 to 317. The median size was 65 students and the mean size was 89. Figure 3 illustrates graphically the range in the number of 11th grade student participants from the lowest to the highest for each of the 4×4 block schools. Similarly, the range of the A/B block schools was 21 to 289. The median and mean size were 65 and 76, respectively (Figure 4). Finally, 19 to 400 was the range of the 8-period day schools, the median size was 51, and the mean was 69 (see Figure 5). As is the case with Iowa high schools, all three groups were comprised primarily of schools that were small to medium in size. Very few large schools were involved in the study. When viewed as a group, Figures 3–5 indicate similar size distributions.

Table 4. Scheduling practices of Iowa high schools

High school scheduling types	Total
Total number high of schools of all types in Iowa in 1999	393
4×4 block-scheduled	
Currently using a 4×4 block schedule	32
Implemented schedule on or before 1997	23
Granted permission to release data	23
Administered the ITED during pre-implementation year and 1999	15
A/B block-scheduled	
Currently using an A/B block schedule	52
Implemented on or before 1997	36
Granted permission to release data	35
Administered the ITED during pre-implementation year and 1999	29
8-period day-scheduled	
Currently using an 8-period day	213
Implemented on or before 1993	175
Number randomly selected	45
Granted permission to release data	42
Total number administering the ITED in 1999	38

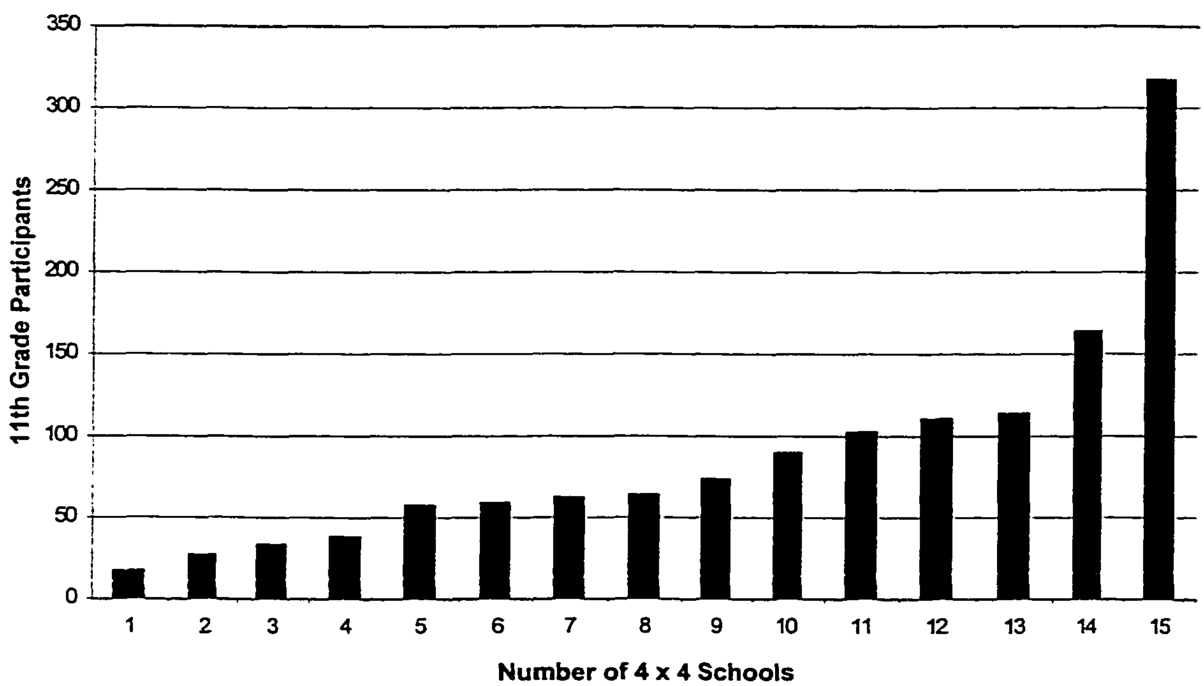

Figure 3. Size of 4×4 block schools

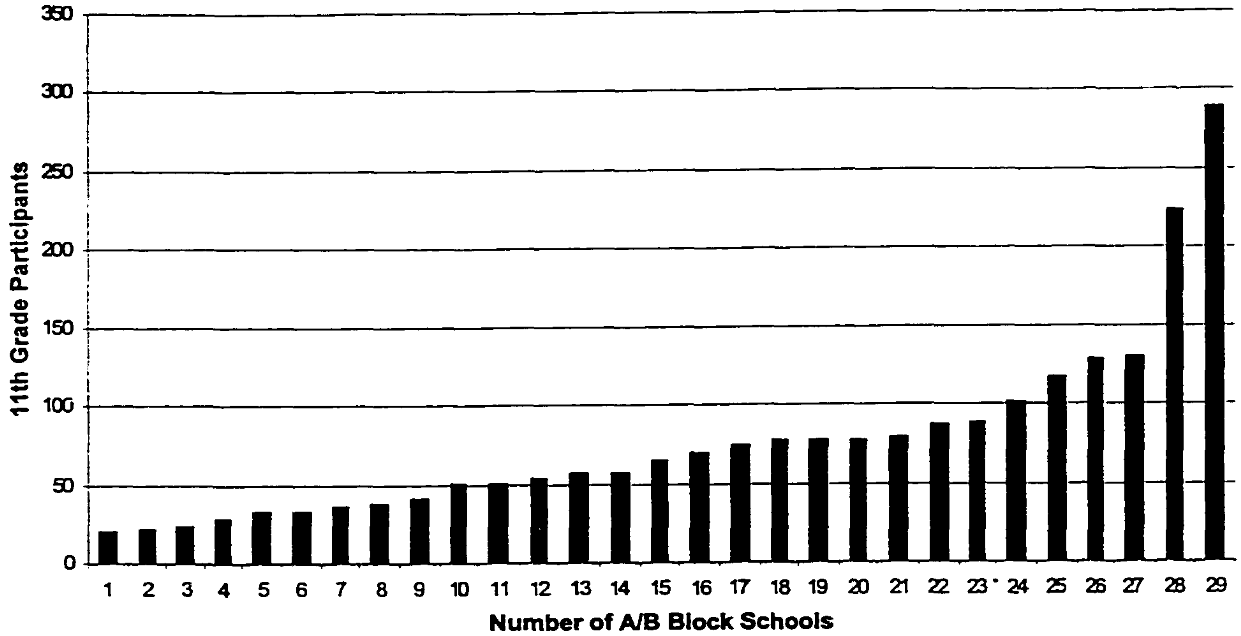

Figure 4. Size of A/B block schools

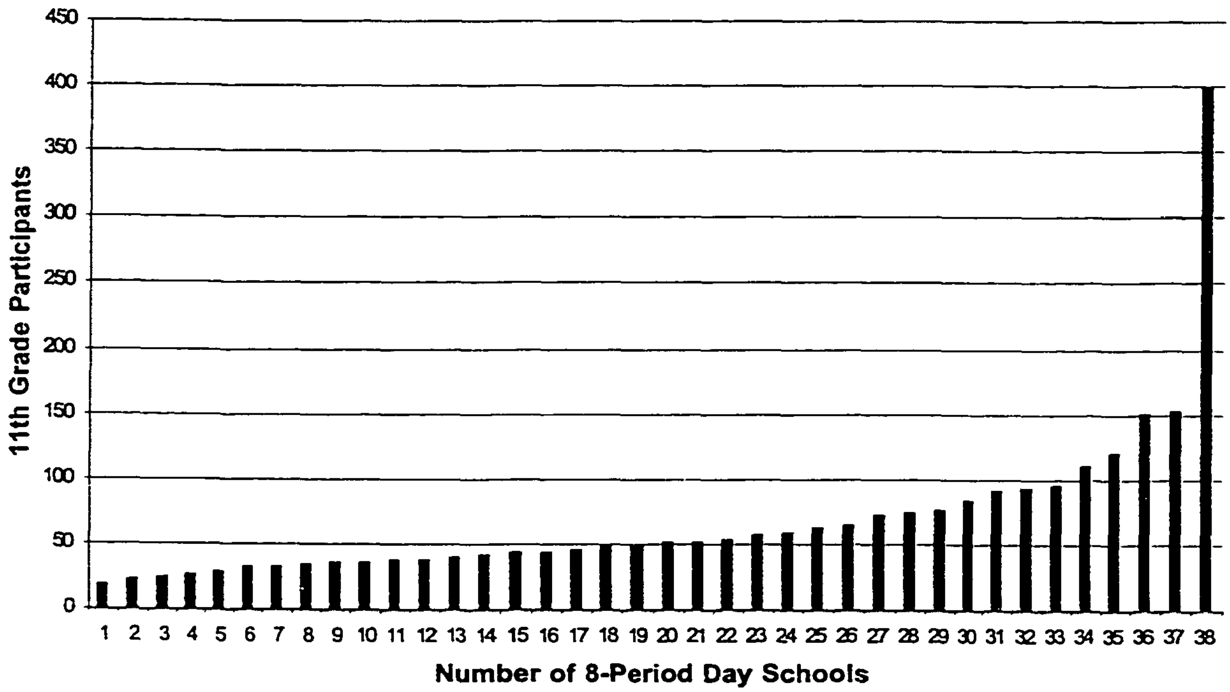

Figure 5. Size of 8-period day schools

In their Comprehensive School Improvement Plan (CSIP) mandate, the Iowa Department of Education requires high schools to report yearly the reading, mathematics, and science scores of 11th grade students. The mean ITED scores in these three areas, in addition to social studies and a composite score, were compared in this study. The statistic used in the study was a standardized mean score of the 11th grade students in the sample school. Comparisons were made between the sample mean scores on the ITED of 11th grade students and the following:

1. The school year before implementation of a 4×4 block schedule and the 1999 ITED scores.
2. The school year before implementation of an A/B alternating day block schedule and the 1999 ITED.
3. 11th grade students from high schools using a 4×4 block schedule for at least two years and the 1999 ITED scores of 11th grade students from a random sample of 8-period day high schools.
4. 11th grade students from high schools using an A/B alternating block schedule for at least two years and the 1999 ITED scores of 11th grade students from a random sample of 8-period day high schools.
5. 11th grade students from high schools using 4×4 and A/B block schedules, an 8-period day, and the state of Iowa norms.

Statement of the Null Hypotheses

The following null hypotheses were tested:

Hypothesis 1a: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an A/B block schedule.

Hypothesis 1b: There is no significant difference controlling for size of school and/or gender.

Hypothesis 2a: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an 8-period day schedule.

Hypothesis 2b: There is no significant difference controlling for size of school and/or gender.

Hypothesis 3a: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and 11th grade students on an 8-period day schedule.

Hypothesis 3b: There is no significant difference controlling for size of school and/or gender.

Hypothesis 4: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and the Iowa state mean for 11th grade students.

Hypothesis 5: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa

Tests of Educational Development between 11^{th} grade students on an A/B block schedule and the Iowa state mean for 11^{th} grade students.

Hypothesis 6a: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block schedule and 11^{th} grade students before adoption of the block schedule in the same school.

Hypothesis 6b: There is no significant difference controlling for size of school and/or gender.

Hypothesis 7a: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on an A/B block schedule and 11^{th} grade students before adoption of the block schedule in the same school.

Hypothesis 7b: There is no significant difference controlling for size of school and/or gender.

Instrument

The Iowa Tests of Educational Development (ITED) is a commonly used standardized achievement test to measure the academic growth and performance of high school students. The ITED is intended to measure students' achievement in the skills that reflect some of the major goals of secondary education. Feldt et al. (1994) stated that these skills consist of recognizing the essentials of correct and effective writing, solving quantitative problems, interpreting a wide variety of reading materials (both literary and informational), critically analyzing discussions of social issues and reports on scientific matters, recognizing sound methods of scientific inquiry, and using sources of information. The authors do not claim that the ITED measured all the objectives of a secondary core curriculum. They do present a sample of tasks demanding the use of important skills that practically all adults use in their daily lives (Iowa Testing Programs, 1993).

Three levels of ITED have been developed: (1) Level 15 for grade 9 students; (2) Level 16 for grade 10 students; and (3) Level 17/18 for grade 11/12 students. Since grade 11 was the targeted class being compared, Level 17/18 was used as the instrument for this study. Forms K and L are given in alternating years. Since the introduction of a new score scale in 1993, the Iowa mean scores of 11th grade students in each of the nine categories of the ITED have declined (Iowa Testing Programs, 1999b). Table 5 lists the standardized mean scores of five areas compared in this study. Note the scores tend to decline from 1993 to 1999. When testing Hypotheses 6 and 7, the 1999 mean scores were adjusted in the 4×4 and A/B block school to account for these decreases.

Table 5. ITED standardized mean scores of 11th grade students in Iowa schools

Test Year	**CAR** Content Area Reading	**Q** Quantitative Thinking	**SS** Social Studies	**SC** Science	**C** Composite
1993	292	296	293	299	292
1994	293	295	293	300	292
1995	292	298	292	299	292
1996	293	296	293	301	292
1997	289	297	290	297	290
1998	290	294	290	298	289
1999	286	295	286	294	287

Validity

The validity of any assessment is dependent on the purpose of the assessment (Borg & Gall, 1989). The main purpose of the ITED is to provide test results that may be used to improve the quality of instruction (Iowa Testing Programs, 1993). When developing the tests, expert authors were used along with an editorial review process and field-testing to established content validity.

Reliability

Test reliability refers to the accuracy of scores over time and between test forms (Borg & Gall, 1989). Reliability levels associated with the ITED are among the highest in the testing industry (Iowa Testing Programs, 1993). The Kuder-Richardson method (KR-20) of determining internal consistency resulted in reliability scores averaging above .88 (Iowa Testing Programs).

Data Collection and Analysis

On September 1, 1999, a total of 104 letters, requesting permission to use their school in the study, were mailed to the superintendents of all 4×4 and A/B alternating block-scheduled schools in Iowa and a random sample of traditionally scheduled 8-period day schools. Eighty schools responded within three weeks. A follow-up letter was sent out the first week of October to the remaining 24 schools that did not respond. All but four returned responses to the second letter. The remaining four school superintendents were contacted by telephone and their responses were faxed to this researcher. All but four school superintendents granted permission for their school to be used in the study. Three 8-period day schools and one A/B alternating day block school declined. Copies of the letter of communication and response postcard are shown in the Appendix.

Once permission from the participating schools was received, the Iowa Testing Programs, located in Iowa City, Iowa, collected the needed Iowa Tests of Educational Development (ITED) scores on the 4×4 block-scheduled schools, the A/B block-scheduled schools, and the randomly selected 8-period day-scheduled schools used in the sample. The unit of analysis was the individual school. To protect the anonymity of the participating school, the Iowa Testing Programs did not release the name of the school that corresponded with the school data. Schools were identified only by schedule type: (a) 4×4 schools were identified with the letter A; (b) A/B schools with the letter B; and (c) 8-period day schools with the letter C. For example, if a school were labeled as "C-4," this researcher knew only that it was an 8-period day school. A spreadsheet of ITED scores from each participating school was sent to the researcher for all years, between and including 1993 and 1999, in which these schools administered the ITED. The year 1993 was selected as the starting point because it was the first year the current K and L forms of the ITED were administered to schools. The spreadsheet also included the number of 11^{th} grade students who had completed the ITED in that particular school in a particular year. Scores also were reported by gender, which allowed the researcher to factor in gender as a main effect and school size as a covariate.

The Statistical Package for the Social Sciences (SPSS) computer package was used to analyze the data. Five of the hypotheses were tested by calculating F-values from a series of two-tailed tests using an analysis of covariance (ANCOVA) as the analytical procedure. Two of the hypotheses were tested using a two-tailed t-test.

CHAPTER IV. RESULTS

The purpose of the study was to determine whether scheduling interventions have an effect on student achievement. The study attempted to determine whether schools using different scheduling models have different scores on the Iowa Tests of Educational Development (ITED).

Included in this chapter is a statistical analysis of the ITED data used to investigate Hypotheses 1-7. For five of the hypotheses, an analysis of covariance (ANCOVA) was used to calculate a series of F scores to determine if statistically significant differences exist between groups of schools using various scheduling models. A two-tailed, one-sample t-test was used to compare student mean performance for different scheduling arrangements against overall state results in two of the hypotheses.

Research Questions and Hypotheses

Two research questions and seven hypotheses were investigated to determine if there were significant differences in student scores on the ITED between schools using different scheduling models. Two research questions guided the overall study and seven hypotheses addressed specific subparts of the research questions. The results are organized based on the null hypotheses testing.

Research Question 1: What is the effect of block scheduling on academic student achievement in Iowa high schools as measured by the Iowa Tests of Educational Development (ITED)?

Research Question 2: Are these differences affected by the size of school and/or gender?

Seven null hypotheses guided the statistical analyses:

Hypothesis 1:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block schedule and 11^{th} grade students on an A/B block schedule.
b. There is no significant difference controlling for size of school and/or gender.

Hypothesis 2:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block-schedule and 11^{th} grade students on an 8-period day schedule?
b. There is no significant difference controlling for size of school and/or gender.

Hypothesis 3:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on an A/B block-schedule and 11^{th} grade students on an 8-period day schedule.
b. There is no significant difference controlling for size of school and/or gender.

Hypothesis 4: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block-schedule and the Iowa state mean scores for 11^{th} grade students.

Hypothesis 5: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on an A/B block-schedule and the Iowa state mean for 11^{th} grade students.

Hypothesis 6:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block-schedule and on 11^{th} grade students in the same school before adoption of the block-schedule.
b. There is no significant difference controlling for size of school and/or gender.

Hypothesis 7:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on an A/B block-schedule and on 11^{th} grade students before adoption of the block-schedule in the same school.

b. There is no significant difference controlling for size of school and/or gender.

Hypothesis Testing

Hypotheses testing were conducted using descriptive and inferential statistics. The results are reported based on the null hypotheses:

Null Hypothesis 1:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block schedule and 11^{th} grade students on an A/B block schedule.

b. There is no significant difference controlling for size of school and/or gender.

The comparisons were first tested for significance without disaggregating the data by gender. Tables 6 and 7 report the results for this part of the testing. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in the performance on the ITED of 11^{th} grade students in 4×4 and A/B block schools. Factoring in the size of the schools yielded no significant difference in the mean scores across both groups.

Reading, mathematics, social studies, and composite mean scores were higher, although not significantly, in the schools using an A/B block-schedule. In addition, 4×4 block school mean scores were higher in science. Standard deviations indicated that the variability of scores in the 4×4 schools was greater than in the A/B block schools.

Table 6. Descriptive statistics comparing 4×4 and A/B block schools

Group		Mean	Std. Deviation	N
Reading	4×4	282.07	13.30	15
	A/B	282.68	9.18	29
Difference		-0.61	4.12	
Mathematics	4×4	290.78	10.46	15
	A/B	291.63	9.71	29
Difference		-0.85	0.75	
Social Studies	4×4	281.95	13.48	15
	A/B	284.22	10.16	29
Difference		-2.27	3.32	
Science	4×4	292.61	12.49	15
	A/B	291.17	10.29	29
Difference		1.44	2.20	
Composite	4×4	283.30	9.89	15
	A/B	283.68	7.40	29
Difference		-0.38	2.49	

Table 7. ANCOVA of 4×4 and A/B block school with size as covariate and group as main effect

Source of Variation		df	Mean Squares	F	Sig. of F
School Size	Reading	1	122.93	1.070	.307
	Mathematics	1	3.66	.036	.850
	Social Studies	1	65.18	.498	.484
	Science	1	8.99	.072	.790
	Composite	1	35.56	.508	.480
Group	Reading	1	8.34	.073	.789
	Mathematics	1	7.97	.079	.781
	Social Studies	1	61.06	.466	.499
	Science	1	18.23	.145	.705
	Composite	1	2.90	.042	.840

The tests were conducted again, disaggregating the results by gender. Tables 8 and 9 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis across the groups of 4×4 and A/B schools. There was no significant difference in the performance on the ITED of 11th grade students in 4×4 and A/B block schools. There was no

Table 8. Comparison of 4×4 and A/B block schools by gender of students

Gender & Group			Mean	Std. Deviation	N
Reading	F	4×4	290.06	9.98	15
		A/B	289.66	9.47	29
Difference			0.40	0.51	
	M	4×4	274.86	18.10	15
		A/B	275.66	14.26	29
Difference			-0.80	3.84	
Mathematics	F	4×4	290.58	9.23	15
		A/B	290.97	9.74	29
Differences			-0.39	-0.51	
	M	4×4	290.99	13.91	15
		A/B	292.71	14.10	29
Difference			-1.72	-0.19	
Social Studies	F	4×4	287.23	10.32	15
		A/B	287.85	10.29	29
Difference			-0.62	0.03	
	M	4×4	277.23	18.10	15
		A/B	280.39	15.93	29
Difference			-3.61	2.17	
Science	F	4×4	297.31	9.97	15
		A/B	295.13	9.04	29
Difference			2.18	0.93	
	M	4×4	288.37	16.57	15
		A/B	287.52	15.50	29
Difference			0.85	1.07	
Composite	F	4×4	288.57	6.58	15
		A/B	288.02	7.35	29
Difference			0.55	-0.77	
	M	4×4	278.19	13.82	15
		A/B	279.42	12.21	29
Difference			-1.23	1.61	

Table 9. ANCOVA of 4×4 and A/B block school with size as covariate and gender/group as main effects

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	133.61	0789	.377
	Mathematics	1	0.84	0006	.940
	Social Studies	1	96.58	0499	.482
	Science	1	0.78	0.005	.947
	Composite	1	38.64	0.359	.550
Gender	Reading	1	4177.50	24.683	.000*
	Mathematics	1	22.93	0.157	.693
	Social Studies	1	1486.94	7.689	.007*
	Science	1	1350.63	7.869	.006*
	Composite	1	1768.18	16.446	.000*
Group	Reading	1	3.56	0.021	.885
	Mathematics	1	22.58	0.155	.695
	Social Studies	1	84.81	0.439	.510
	Science	1	43.77	0.255	.615
	Composite	1	4.30	0.040	.842
Gender/Group	Reading	1	9.59	0.057	.789
	Mathematics	1	8.95	0.061	.781
	Social Studies	1	36.33	0.188	.499
	Science	1	9.01	0.053	.705
	Composite	1	17.46	0.162	.840

*Significant at $p \leq .05$

significant difference in scores when the size of schools or the interaction of gender and group were controlled. Except for mathematics, females significantly outperformed males across both groups.

Mean scores for females in mathematics and social studies were higher in the schools using an A/B block-schedule. Female students' mean scores in 4×4 block schools were higher in reading, science, and the composite score. Male students in A/B block schools outperformed male students in 4×4 block schools in every ITED area, except for science.

Standard deviations indicated that variability of scores in the 4×4 schools was greater than in the A/B block schools in all areas excluding mathematics and the female students' composite scores. The standard deviations of male scores were greater than those for females in every case.

Null Hypothesis 2:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block-schedule and 11th grade students on an 8-period day schedule.*
b. *There also is no significant difference controlling for size of school and/or gender.*

The comparisons were first tested for significance without disaggregating the data by gender. Tables 10 and 11 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in the performance on the ITED of 11th grade students in 4×4 block-scheduled schools and 8-period day schools. Factoring in the size of the schools yielded no significant difference in the mean scores across both groups.

Average reading, mathematics, social studies, science, and composite mean scores were higher, although not significantly, in the schools using an eight-period schedule. Standard deviations indicate that variability of scores in the 4×4 schools was greater than in the 8-period day schools.

The tests were conducted again, disaggregating the results by gender. Tables 12 and 13 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis across the groups of 4×4 block-scheduled schools and 8-period day schools in the subject areas of reading, mathematics, and science. The null hypothesis was rejected at the

Table 10. Comparison of 4×4 block and 8-period day schools

Group		Mean	Std. Deviation	N
Reading	4×4	282.07	13.30	15
	8-period	285.83	10.24	38
Difference		-3.76	3.06	
Mathematics	4×4	290.78	10.46	15
	8-period	294.24	9.41	38
Difference		-3.46	1.05	
Social Studies	4×4	281.95	13.48	15
	8-period	287.32	10.72	38
Difference		-5.37	2.76	
Science	4×4	292.61	12.49	15
	8-period	294.95	11.49	38
Difference		-2.34	1.00	
Composite	4×4	283.30	9.89	15
	8-period	287.39	8.82	38
Difference		-4.09	1.07	

Table 11. ANCOVA of 4×4 block and 8-period day schools with size as covariate and group as main effect

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	409.06	3.439	.070
	Mathematics	1	343.35	3.847	.055
	Social Studies	1	503.95	4.005	.051
	Science	1	313.35	2.319	.134
	Composite	1	308.20	3.915	.053
Group	Reading	1	226.16	1.902	.174
	Mathematics	1	190.84	2.138	.150
	Social Studies	1	422.31	3.356	.073
	Science	1	101.40	0.750	.391
	Composite	1	247.25	3.140	.082

Table 12. Comparison of 4×4 block and 8-period day schools by gender of students

Gender & Group			Mean	Std. Deviation	N
Reading	F	4×4	290.06	9.98	15
		8-period	292.42	11.28	38
Difference			-2.36	-1.30	
	M	4×4	274.86	18.10	15
		8-period	278.71	12.25	38
Difference			-3.85	5.85	
Mathematics	F	4×4	290.58	9.23	15
		8-period	292.77	10.19	38
Difference			-2.19	-0.96	
	M	4×4	290.99	13.91	15
		8-period	296.10	12.17	38
Difference			-5.11	1.74	
Social Studies	F	4×4	287.23	10.32	15
		8-period	290.97	12.08	38
Difference			-3.74	-1.76	
	M	4×4	277.23	18.10	15
		8-period	283.56	11.76	38
Difference			-6.33	6.34	
Science	F	4×4	297.31	9.97	15
		8-period	298.42	12.86	38
Difference			-1.11	-2.89	
	M	4×4	288.37	16.57	15
		8-period	291.05	14.42	38
Difference			-2.68	2.15	
Composite	F	4×4	288.57	6.58	15
		8-period	291.40	9.38	38
Difference			-2.83	-2.80	
	M	4×4	278.19	13.82	15
		8-period	283.01	10.76	38
Difference			-4.82	3.06	

Table 13. ANCOVA of 4×4 block and 8-period day schools with size as covariate and gender/group as main effects

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	777.73	5.079	.026*
	Mathematics	1	650.59	5.226	.024*
	Social Studies	1	935.64	6.038	.016*
	Science	1	653.47	3.588	.061
	Composite	1	629.40	6.237	.014*
Gender	Reading	1	4477.06	29.237	.000*
	Mathematics	1	76.91	0.618	.434
	Social Studies	1	1620.60	10.458	.002*
	Science	1	1421.58	7.806	.006*
	Composite	1	1886.25	18.692	.000*
Group	Reading	1	328.45	2.145	.146
	Mathematics	1	412.67	3.315	.072
	Social Studies	1	748.52	4.830	.030*
	Science	1	150.53	0.827	.365
	Composite	1	443.79	4.398	.038*
Gender/Group	Reading	1	15.50	0.101	.751
	Mathematics	1	51.93	0.417	.520
	Social Studies	1	42.36	0.273	.602
	Science	1	16.66	0.091	.763
	Composite	1	25.27	0.250	.618

*Significant at $p \leq .05$

.05 level when comparing the mean scores of the two groups in social studies and composite. Social studies and composite ITED scores of 11th grade students were significantly higher in eight-period scheduled schools when compared with 4×4 block-scheduled schools. Factoring in the size of the schools yielded a significant difference in the mean scores across both groups in all areas with the exception of science. The larger schools produced significantly higher mean scores on the reading, mathematics, social studies, and composite tests. There was no significant difference in scores when the interaction of gender and group was controlled. Except for mathematics, females significantly outperformed males across both groups.

The mean scores for both females and males in 8-period day schools were higher, although not significantly, than in 4×4 block schools. Standard deviations indicate that variability of female students' scores in the 4×4 schools was smaller than for the 8-period day school in all areas. In contrast, the standard deviation of male scores in 4×4 schools was greater in all areas than for males in 8-period schools. The standard deviations of male scores were greater than those for females in every case except with female students' social studies scores in 8-period day schools.

Null Hypothesis 3:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block-schedule and 11th grade students on an 8-period day schedule.*
b. *There also is no significant difference controlling for size of school and/or gender.*

The comparisons were first tested for significance without disaggregating the data by gender. Tables 14 and 15 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in the performance on the ITED by 11th grade students in A/B block-scheduled schools and 8-period day schools. Factoring in the size of the schools yielded no significant difference in the mean scores across both groups.

Reading, mathematics, social studies, science, and composite mean scores were higher, although not significantly, in the schools using an 8-period schedule. Standard

Table 14. Comparison of A/B block and 8-period day schools

Group		Mean	Std. Deviation	N
Reading	A/B	282.68	9.18	29
	8-period	285.83	10.24	38
Difference		-3.15	-1.06	
Mathematics	A/B	291.63	9.71	29
	8-period	294.24	9.41	38
Difference		-2.61	0.30	
Social Studies	A/B	284.22	10.16	29
	8-period	287.32	10.72	38
Difference		-3.10	-0.56	
Science	A/B	291.17	10.29	29
	8-period	294.95	11.49	38
Difference		-3.78	-1.20	
Composite	A/B	283.68	7.40	29
	8-period	287.39	8.82	38
Difference		-3.71	-1.42	

Table 15. ANCOVA of A/B block and 8-period day schools with size as covariate and group as main effect

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	191.68	2.029	.159
	Mathematics	1	201.16	2.254	.138
	Social Studies	1	179.01	1.645	.204
	Science	1	104.36	0.863	.357
	Composite	1	136.56	2.046	.157
Group	Reading	1	188.86	1.999	.162
	Mathematics	1	133.95	1.501	.225
	Social Studies	1	181.74	1.670	.201
	Science	1	257.70	2.130	.149
	Composite	1	251.25	3.765	.057

deviation values indicate that variability of scores in the 8-period day schools was greater than in the A/B block schools in every area, except for mathematics.

The tests were calculated again, disaggregating the results by gender. Tables 16 and 17 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis across the groups of A/B block-scheduled schools and 8-period day schools in the

Table 16. Comparison of A/B block and 8-period day schools by gender of students

Gender & Group			Mean	Std. Deviation	N
Reading	F	A/B	289.66	9.47	29
		8-period	292.42	11.28	38
Difference			-2.76	-1.81	
	M	A/B	275.66	14.26	29
		8-period	278.71	12.25	38
Difference			-3.05	2.01	
Mathematics	F	A/B	290.97	9.74	29
		8-period	292.77	10.19	38
Difference			-1.80	-0.45	
	M	4x4	292.71	14.10	29
		8-period	296.10	12.17	38
Difference			-3.39	1.93	
Social Studies	F	A/B	287.85	10.29	29
		8-period	290.97	12.08	38
Difference			-3.12	-1.79	
	M	A/B	280.39	15.93	29
		8-period	283.56	11.76	38
Difference			-3.17	4.17	
Science	F	A/B	295.13	9.04	29
		8-period	298.42	12.86	38
Difference			-3.29	-3.82	
	M	A/B	287.52	15.50	29
		8-period	291.05	14.42	38
Difference			-3.53	1.08	
Composite	F	A/B	288.02	7.35	29
		8-period	291.40	9.38	38
Difference			-3.38	-2.03	
	M	A/B	279.42	12.21	29
		8-period	283.01	10.76	38
Difference			-3.59	1.45	

Table 17. ANCOVA of A/B block and 8-period day schools with size as covariate and gender/group as main effects

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	322.59	2.293	.132
	Mathematics	1	310.47	2.324	.130
	Social Studies	1	332.61	2.119	.148
	Science	1	186.74	1.064	.304
	Composite	1	234.83	2.332	.129
Gender	Reading	1	6172.09	43.880	.000*
	Mathematics	1	234.35	1.754	.188
	Social Studies	1	1744.92	11.117	.001*
	Science	1	1786.71	10.179	.002*
	Composite	1	2304.71	22.883	.000*
Group	Reading	1	320.08	2.276	.134
	Mathematics	1	259.55	1.943	.166
	Social Studies	1	372.36	2.372	.126
	Science	1	419.27	2.389	.125
	Composite	1	441.52	4.384	.038*
Gender/Group	Reading	1	0.23	.002	.968
	Mathematics	1	17.69	.132	.716
	Social Studies	1	0.07	.000	.983
	Science	1	0.16	.001	.976
	Composite	1	0.08	.001	.977

*Significant at $p \leq .05$

subject areas of reading, mathematics, social studies, and science. The null hypothesis was rejected at the .05 level when comparing the composite mean scores of the two groups. There was a significant difference in composite mean scores in the performance on ITED of 11^{th} grade students in A/B block schools and 8-period scheduled schools. Factoring in the size of the schools yielded no significant difference in the mean scores across both groups in all areas. There was no significant difference in scores when the interaction of gender and group was controlled. Except for mathematics, females significantly outperformed males across both groups.

Mean scores for both females and males in 8-period day schools were higher, although not significantly, than in A/B block schools. Standard deviations indicate that variability of females' scores in the A/B schools was smaller than in the 8-period day schools in every area, except for social studies. In contrast, the standard deviation of A/B males was greater in all areas. The standard deviations of males' scores were greater than those for females in every case except for females' social studies scores in 8-period day schools.

Null Hypothesis 4: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block-schedule and the Iowa state mean scores for 11th grade students.

The comparisons were tested for significance without disaggregating the data by size of school or gender. Tables 18 and 19 report the results for this part of the testing. Calculated t-scores from one-sample test failed to reject the null hypothesis. There was no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the ITED between 11th grade students on a 4×4 block-schedule and the Iowa state mean scores for 11th grade students.

Iowa state mean scores were higher in reading, mathematics, social studies, science, and composite mean scores, although not significantly, as compared with the schools using a 4×4 block schedule.

Table 18. Comparison of 4×4 block schools and Iowa state mean scores

Group	Test Value	Mean	Std. Deviation	Std. Error Mean	N
Reading	286	282.07	13.30	3.43	15
Mathematics	295	290.08	10.46	2.70	15
Social Studies	286	281.95	13.48	3.48	15
Science	294	292.61	12.49	3.23	15
Composite	287	283.30	9.89	2.55	15

Table 19. One-sample t-test statistics for 4×4 block schools and Iowa state mean scores

Group	t	df	Sig. (2-tailed)	Mean Difference
Reading	-1.144	14	.272	-3.93
Mathematics	-1.563	14	.140	-4.22
Social Studies	-1.163	14	.264	-4.05
Science	-.430	14	.674	-1.39
Composite	-1.449	14	.169	-3.70

Figure 6 illustrates visually how the ITED scores of schools that converted to a 4×4 block schedule in 1995 compared to the Iowa state mean during their pre-implementation year (1994). For example, in Figure 6, A22 is one of the schools that converted to a 4×4 block schedule in 1995. That year's CAR score was approximately 294.5. In Figure 7, the same school's 1999 scores are compared with the 1999 Iowa state means. From Figure 7, the A22 CAR score was 296.8. Similarly, Figures 8–11 do the same for schools converting in 1996 and 1997. In each figure, the state mean legend is denoted with a dashed line. By counting the pre-implementation scores in reading, mathematics, social studies, science, and the composite above each state mean, there are 36 scores out of a possible 75 above the state mean during the pre-implementation year versus 34 scores out of a possible 75 above in 1999.

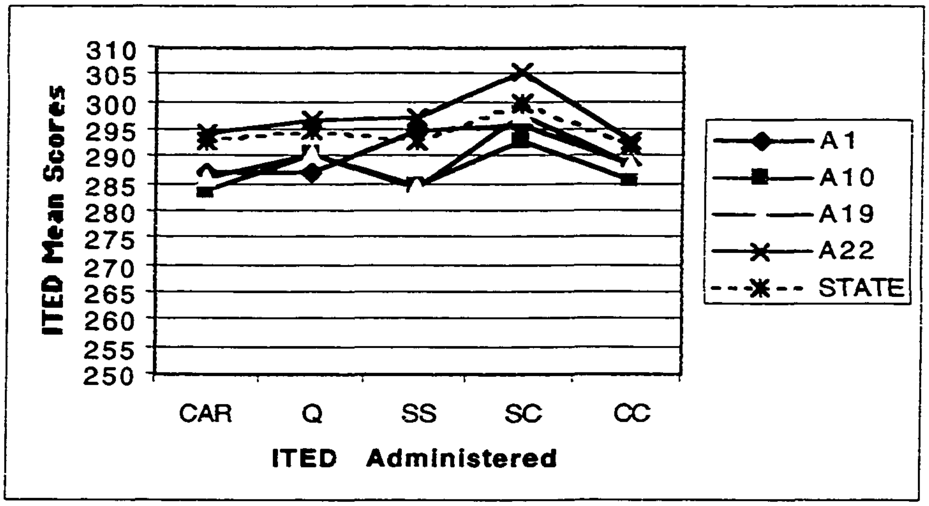

Figure 6. Comparison of 1994 pre-implementation year and the 1994 state means for schools converting to a 4x4 block schedule in 1995

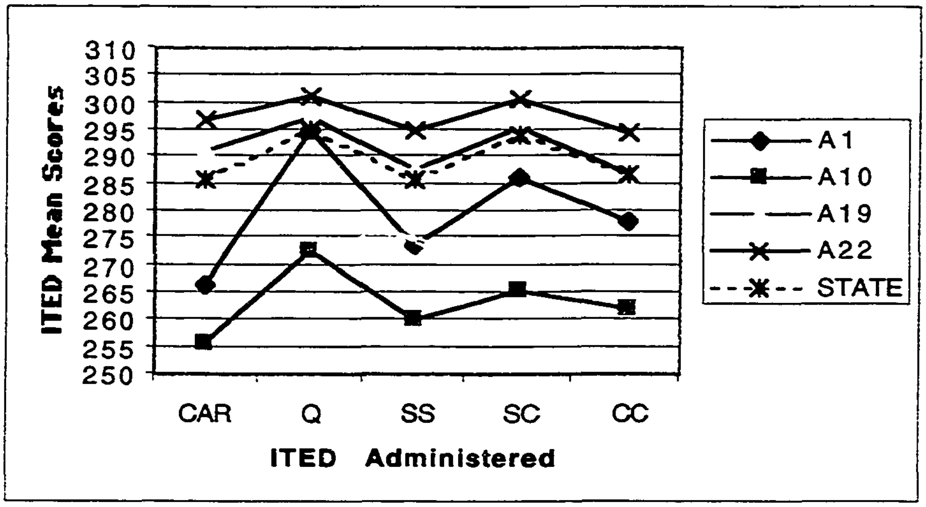

Figure 7. Comparison of 1999 mean scores of the schools that converted to a 4x4 block schedule in 1995 and the 1999 state means

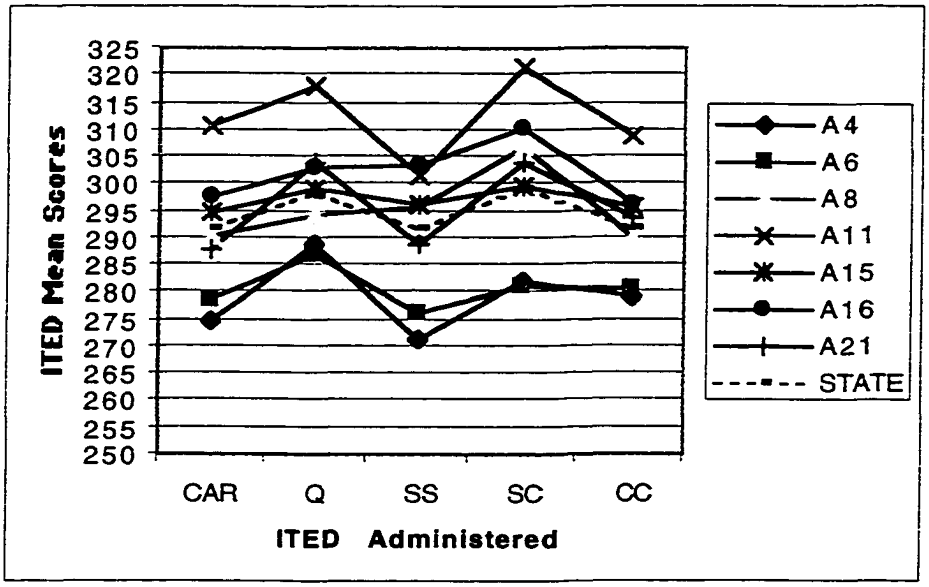

Figure 8. Comparison of 1995 pre-implementation and 1995 state means for schools converting to a 4x4 block schedule in 1996

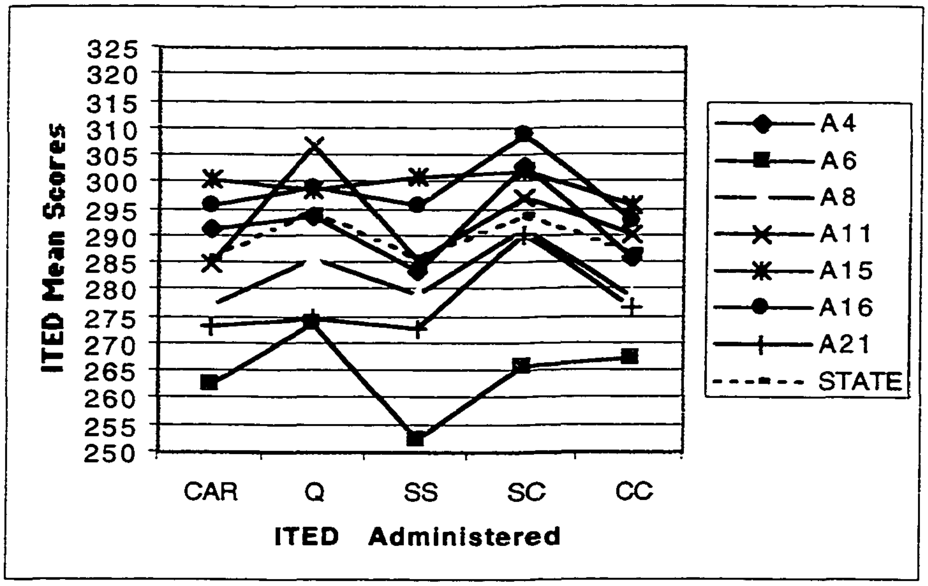

Figure 9. Comparison of 1999 mean scores of the schools that converted to a 4x4 block schedule in 1996 and the 1999 state means

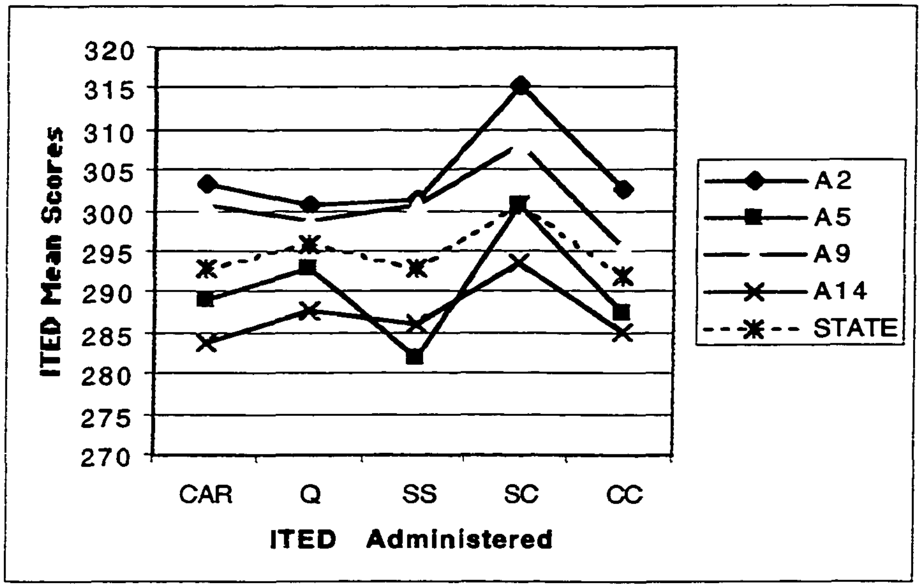

Figure 10. Comparison of 1996 pre-implementation year and the 1996 state means for schools converting to a 4×4 block schedule in 1997

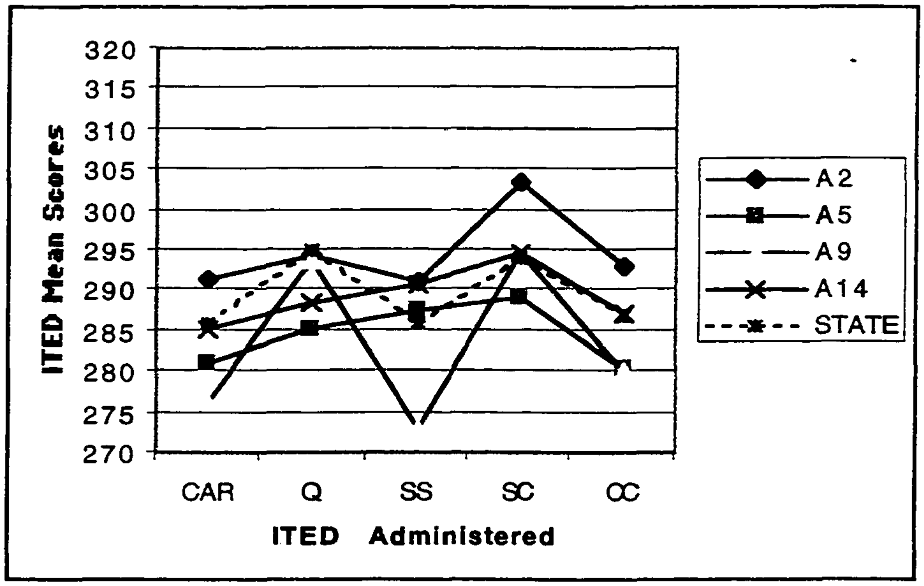

Figure 11. Comparison of 1999 mean scores of the schools that converted to a 4×4 block schedule in 1997 and the 1999 state means

Null Hypothesis 5: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block-schedule and the Iowa state mean for 11th grade students.

The comparisons were tested for significance without disaggregating the data by size of school or gender. Tables 20 and 21 report the results for this part of the testing. Calculated t-scores from a one-sample test failed to reject the null hypothesis in all curriculum areas, except for composite scores. There was no significant difference in student performance in mathematics, reading, science, and social studies as measured by mean scores on the ITED between 11th grade students on a A/B block-schedule and the Iowa state mean scores for 11th grade students. The difference in composite scores was statistically significant. Iowa state

Table 20. Comparison of A/B block schools and Iowa state mean scores

Group	Test Value	Mean	Std. Deviation	Std. Error Mean	N
Reading	286	282.68	9.18	1.70	29
Mathematics	295	291.63	9.71	1.80	29
Social Studies	286	284.22	10.16	1.89	29
Science	294	291.17	10.29	1.91	29
Composite	287	283.68	7.40	1.37	29

Table 21. One-sample t-test statistics for A/B block schools and Iowa state mean scores

Group	t	df	Sig. (2-tailed)	Mean Difference
Reading	-1.947	28	.062	-3.32
Mathematics	-1.871	28	.072	-3.37
Social Studies	-.943	28	.354	-1.78
Science	-1.484	28	.149	-2.83
Composite	-2.419	28	.022*	-3.32

*Significant at $p \leq .05$

mean scores were higher in reading, mathematics, social studies, science, and composite mean scores than in the schools using an A/B block schedule.

Figure 12 illustrates visually how the ITED scores of schools that converted to an A/B block-schedule in 1994 compared to the Iowa state means during their pre-implementation year (1993). In Figure 13, the same schools' 1999 scores are compared with the 1999 Iowa state means. Similarly, Figure 14–17 do the same for schools converting in 1995, 1996, and 1997. By counting the pre-implementation scores in reading, mathematics, social studies, science, and the composite above each state mean, there are 44 scores out of a possible 145 above the state mean during the pre-implementation year, versus 52 scores out of a possible 145 above in 1999.

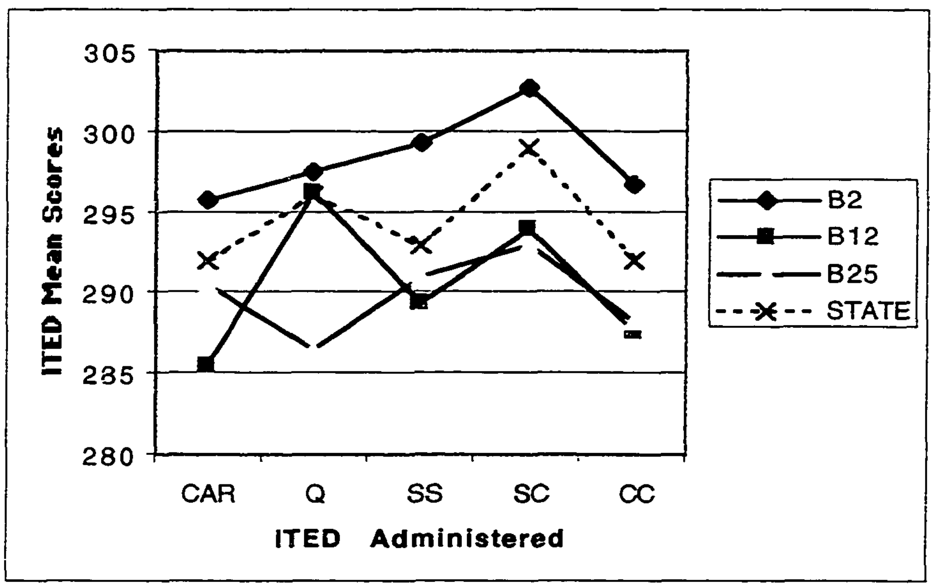

Figure 12. Comparison of the 1993 pre-implementation year and the 1993 state means for schools converting to an A/B block schedule in 1994

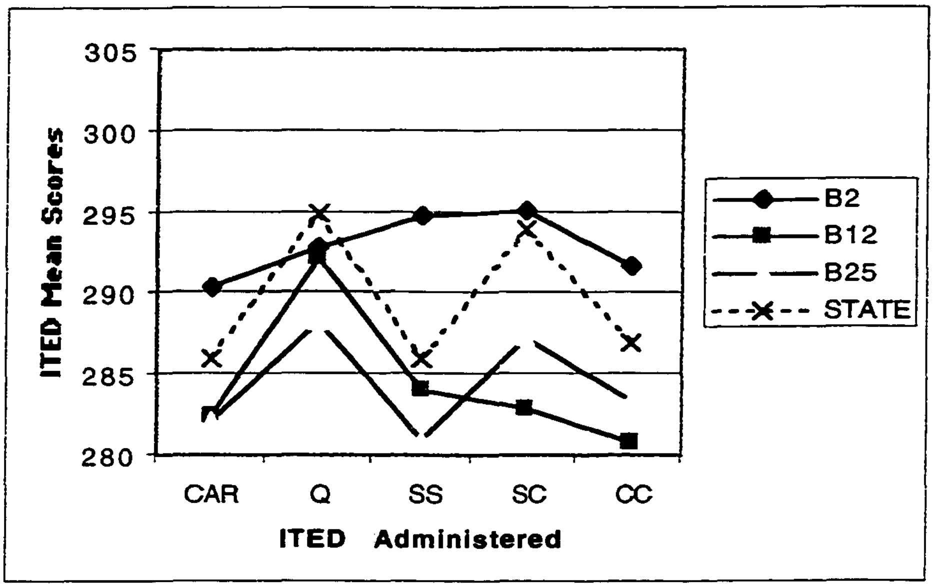

Figure 13. Comparison of 1999 mean scores of the schools that converted to an A/B block schedule in 1994 and the 1999 state means

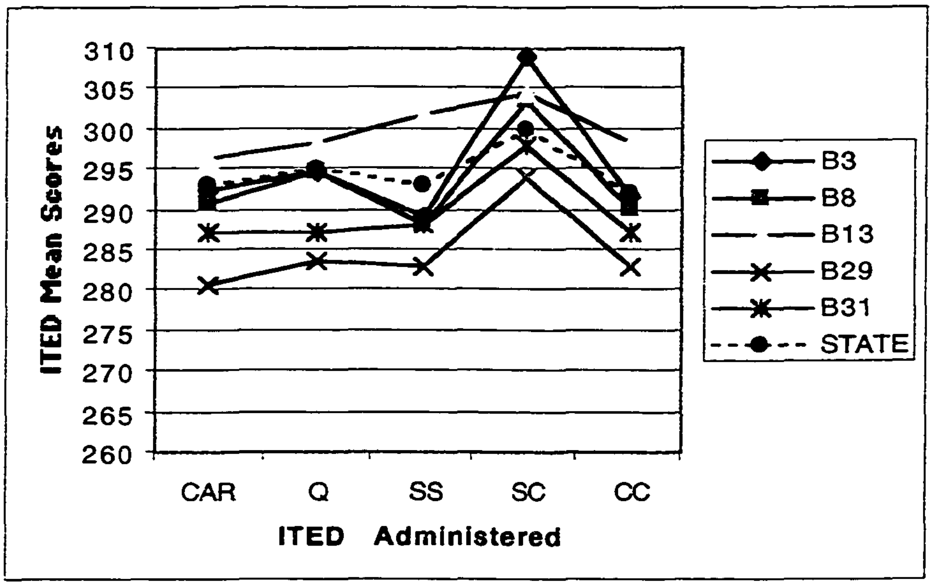

Figure 14. Comparison of the 1994 pre-implementation year and the 1994 state means for schools converting to an A/B block schedule in 1995

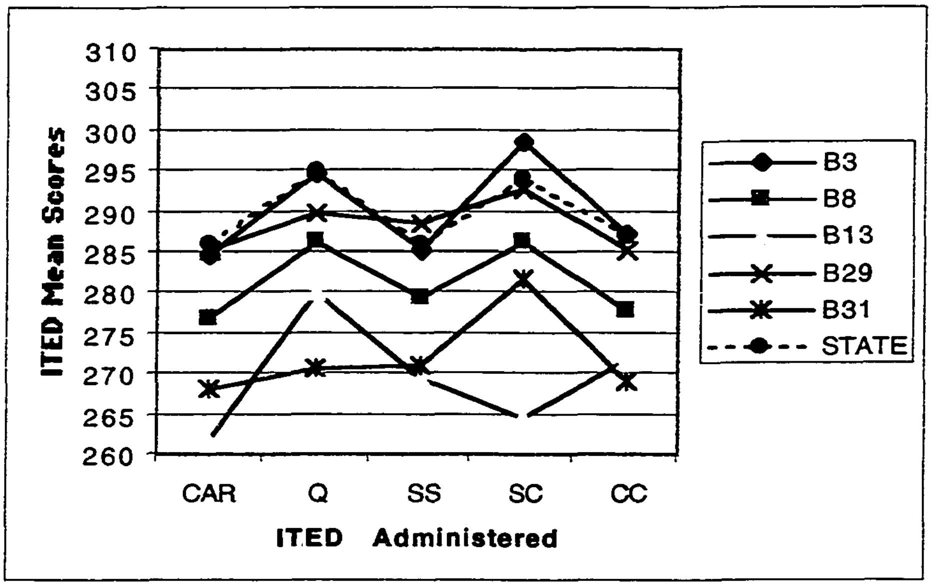

Figure 15. Comparison of 1999 mean scores of the schools that converted to an A/B block schedule in 1995 and the 1999 state means

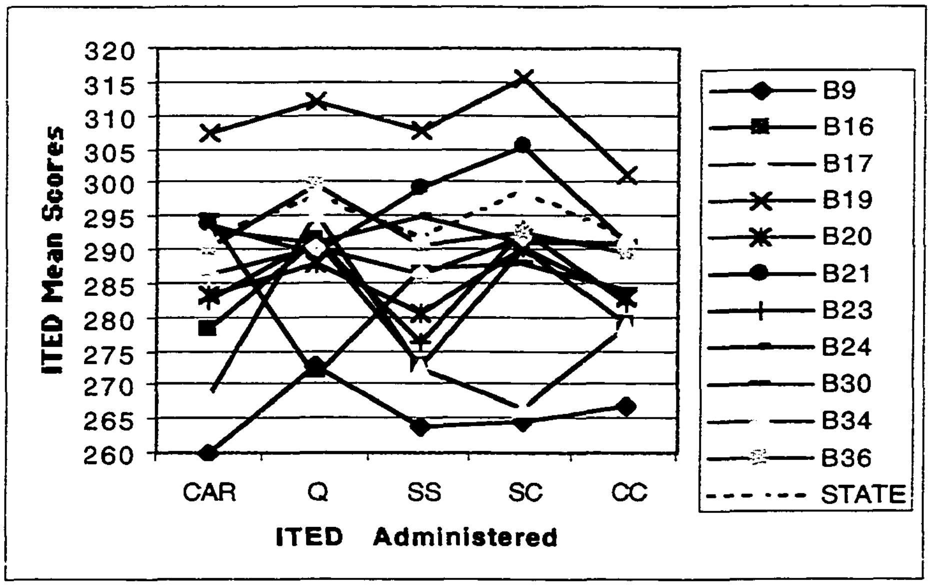

Figure 16. Comparison of the 1995 pre-implementation year and the 1995 state means for schools converting to an A/B block schedule in 1996

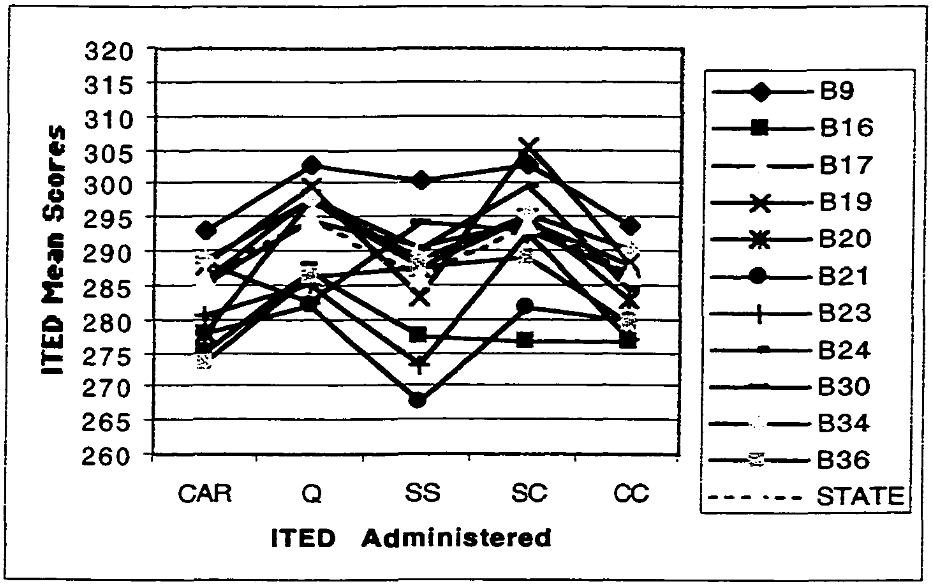

Figure 17. Comparison of 1999 mean scores of the schools that converted to an A/B block schedule in 1996 and the 1999 state means

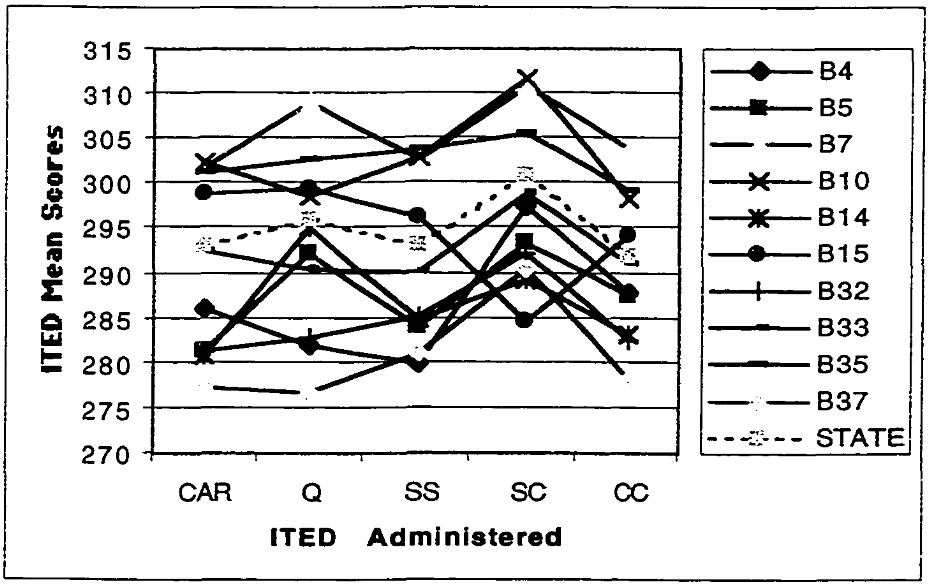

Figure 18. Comparison of the 1996 pre-implementation year and the 1996 state means for schools converting to an A/B block schedule in 1997

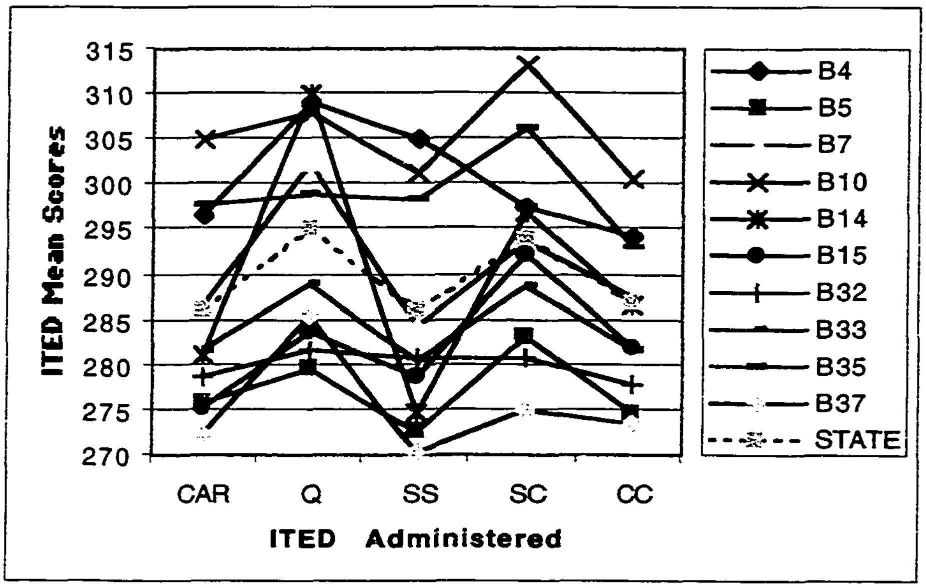

Figure 19. Comparison of 1999 mean scores of the schools that converted to an A/B block schedule in 1997 and the 1999 state means

Null Hypothesis 6:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and on 11th grade students in the same school before adoption of the block schedule.*

b. *There is no significant difference controlling for size of school and/or gender.*

Since 1993, the ITED means scores for Iowa schools in the content areas of reading, mathematics, social studies, science, and the composite have declined (Iowa Testing Programs, 1999b). To adjust for these decreases, the difference of the state mean scores of the year preceding the implementation of block scheduling and the 1999 state mean scores was added to 1999 mean scores of the 4×4 block schools.

The comparisons were first tested for significance without disaggregating the data by gender. Tables 22 and 23 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in student performance on the ITED between 11th grade students in 1999 on a 4×4 block schedule and 11th grade students in the same school the year before adoption of the block schedule. Factoring in the size of the schools yielded no significant difference in the mean scores across both years.

Table 22. Comparison of the 4×4 schools the year preceding implementation of block and 1999

Group		Mean	Std. Deviation	N
Reading	year before	290.98	9.56	15
	1999	288.61	13.24	15
Difference		2.37	-3.68	
Mathematics	year before	296.05	8.41	15
	1999	292.45	10.48	15
Difference		3.60	-2.07	
Social Studies	year before	291.08	9.90	15
	1999	288.49	13.51	15
Difference		2.59	-3.61	
Science	year before	301.17	11.21	15
	1999	298.55	12.51	15
Difference		2.62	-1.30	
Composite	year before	291.51	7.86	15
	1999	288.30	9.89	15
Difference		3.21	-2.03	

Reading, mathematics, social studies, science, and composite mean scores were higher, although not significantly, in the year preceding the implementation of block scheduling. Standard deviations indicate that variability of scores in the 4×4 schools was greater in 1999 than in the year preceding the implementation of block scheduling.

Table 23. ANCOVA of 4×4 schools comparing the year preceding implementation of block and 1999 with size as covariate and group as main effect

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	140.20	1.054	.314
	Mathematics	1	11.25	0.121	.731
	Social Studies	1	180.09	1.298	.265
	Science	1	12.38	0.085	.773
	Composite	1	60.99	0.758	.392
Group	Reading	1	44.38	0.333	.568
	Mathematics	1	98.09	1.053	.314
	Social Studies	1	53.08	0.383	.541
	Science	1	53.17	0.358	.555
	Composite	1	79.00	0.982	.331

The tests were conducted again, disaggregating the results by gender. Tables 24 and 25 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in student performance on the ITED between 11th grade students in 1999 on a 4×4 block schedule and 11th grade students in the same school the year before adoption of the block schedule. Factoring in the size of the schools and gender yielded no significant difference in the mean scores across both years. There was no significant difference in scores when the interaction of gender and group was controlled. Except for mathematics and science, females significantly outperformed males across both years.

Pre-implementation mean scores were higher, although not significantly, in all categories with the exception of reading, social studies, and science scores for females. Except for females in science and composite areas, standard deviations indicate that variability of scores in the 4×4 schools was greater in 1999 than in the year preceding the implementation of the block schedule. The standard deviations of male scores were greater than those of females in every case.

Table 24. Comparison of the 4×4 schools the year preceding implementation of block scheduling and 1999 by gender

Gender & Group			Mean	Std. Deviation	N
Reading	F	year before	295.61	8.95	15
		1999	296.59	9.86	15
Difference			-0.98	-0.91	
	M	year before	285.75	14.01	15
		1999	281.39	18.10	15
Difference			4.36	-4.09	
Mathematics	F	year before	293.36	8.06	15
		1999	292.25	9.38	15
Difference			1.11	-1.32	
	M	year before	298.40	10.49	15
		1999	292.65	13.84	15
Difference			4.75	-3.35	
Social Studies	F	year before	293.25	9.83	15
		1999	293.77	10.28	15
Difference			-0.52	-0.45	
	M	year before	288.47	13.24	15
		1999	283.77	18.18	15
Difference			4.70	-4.94	
Science	F	year before	302.29	12.29	15
		1999	303.11	9.85	15
Difference			-0.82	2.44	
	M	year before	299.33	14.17	15
	1999		294.17	16.70	15
Difference			5.16	-2.53	
Composite	F	year before	294.34	6.69	15
		1999	293.57	6.58	15
Difference			0.77	0.11	
	M	year before	288.26	11.13	15
		1999	283.19	13.82	15
Difference			5.07	-2.69	

Table 25. ANCOVA of 4×4 school the year preceding implementation of block scheduling and 1999 with size as covariate and group/gender as main effects

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	255.94	1.472	.230
	Mathematics	1	28.94	.251	.618
	Social Studies	1	340.66	1.957	.167
	Science	1	27.90	.151	.699
	Composite	1	128.49	1.282	.262
Gender	Reading	1	2363.97	13.594	.001*
	Mathematics	1	110.59	.960	.331
	Social Studies	1	825.31	4.742	.034*
	Science	1	532.44	2.883	.095
	Composite	1	1020.17	10.180	.002*
Group	Reading	1	45.72	.263	.610
	Mathematics	1	178.39	1.549	.219
	Social Studies	1	70.06	.403	.528
	Science	1	72.27	.391	.534
	Composite	1	131.67	1.314	.257
Gender/Group	Reading	1	109.51	.630	.431
	Mathematics	1	81.25	.705	.405
	Social Studies	1	105.09	.604	.440
	Science	1	135.04	.731	.396
	Composite	1	70.80	.707	.404

*Significant at $p \leq .05$

Null Hypothesis 7:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and on 11th grade students before adoption of the block schedule in the same school.*

b. *There is no significant difference controlling for size of school and/or gender.*

Since 1993, the ITED means scores for Iowa schools in the content areas of reading, mathematics, social studies, science, and the composite have declined (Iowa Testing Programs, 1999b). To adjust for these decreases, the difference between the state mean scores of the year preceding the implementation of block scheduling and the 1999 state mean scores was added to the 1999 mean scores of the A/B block schools.

The comparisons were first tested for significance without disaggregating the data by gender. Tables 26 and 27 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in student performance on the ITED between 11th grade students in 1999 on an A/B block schedule and 11th grade students in the same school the year before adoption of the block schedule. Factoring in the size of the schools yielded no significant difference in the mean scores across both years.

Reading, mathematics, social studies, science, and composite 1999 mean scores were higher, although not significantly. Standard deviation values indicate that variability of scores in the year preceding the switch to the block was greater than for 1999 scores in the areas of reading, social studies, science, and the composite. Mathematics was the lone exception.

Table 26. Comparison of the A/B schools the year preceding implementation of block scheduling and 1999

Group		Mean	Std. Deviation	N
Reading	year before	288.38	10.38	29
	1999	289.20	9.14	29
Difference		-0.82	1.24	
Mathematics	year before	291.80	9.37	29
	1999	293.21	9.96	29
Difference		-1.41	-0.95	
Social Studies	year before	288.79	10.49	29
	1999	290.84	10.12	29
Difference		-2.05	0.37	
Science	year before	295.32	11.43	29
	1999	297.03	10.33	29
Difference		-1.71	1.10	
Composite	year before	288.54	8.03	29
	1999	288.68	7.40	29
Difference		-0.14	0.63	

Table 27. ANCOVA of A/B school the year preceding implementation of block and the year 1999 with size and group main effects

Source of Variation		df	Mean Squares	F	Sig of F
School Size	Reading	1	56.12	.583	.449
	Mathematics	1	1.85	.019	.890
	Social Studies	1	29.35	.273	.603
	Science	1	35.51	.295	.589
	Composite	1	18.39	.304	.583
Group	Reading	1	7.11	.074	.787
	Mathematics	1	27.83	.293	.591
	Social Studies	1	55.86	.519	.474
	Science	1	37.25	.310	.580
	Composite	1	0.06	.001	.975

The tests then were conducted again, disaggregating by gender. Tables 28 and 29 report the results. Calculated F-scores from the ANCOVA failed to reject the null hypothesis. There was no significant difference in student performance on the ITED between 11th grade students in 1999 on an A/B block schedule and 11th grade students in the same school the year before adoption of the block schedule. Factoring in the size of the schools and gender yielded no significant difference in the mean scores across both years. There was no significant difference in scores when the interaction of gender and group was controlled. Females significantly outperformed males across both years, except for mathematics.

Reading, mathematics, social studies, science mean scores, and female students' composite mean scores were higher in the 1999 year of A/B block scheduling, although not significantly. Except for male mathematics, social studies, science, and composite scores, standard deviation scores indicate that 1999 variability of scores in the A/B schools was less than in the year preceding the implementation of A/B block scheduling. Excluding mathematics, the standard deviations among males were greater than those among females in every case.

Table 28. Comparison of the A/B schools the year preceding implementation of block scheduling and 1999 by gender

Gender & Group			Mean	Std. Deviation	N
Reading	F	year before	294.56	10.51	29
		1999	295.97	9.49	29
Difference			-1.41	1.02	
	M	year before	281.65	14.63	29
		1999	281.73	13.89	29
Difference			-0.08	0.84	
Mathematics	F	year before	289.96	12.48	29
		1999	292.45	9.90	29
Difference			-2.49	2.58	
	M	year before	293.78	9.10	29
		1999	294.19	14.33	29
Difference			-0.41	-5.23	
Social Studies	F	year before	291.71	11.28	29
		1999	294.26	10.26	29
Difference			-2.55	1.02	
	M	year before	285.70	13.63	29
		1999	286.81	15.85	29
Difference			-1.11	-2.22	
Science	F	year before	298.67	12.86	29
		1999	300.82	9.12	29
Difference			-2.15	3.74	
	M	year before	291.53	14.04	29
	1999		293.21	15.47	29
Difference			-1.68	-1.43	
Composite	F	year before	292.15	9.28	29
		1999	292.85	7.29	29
Difference			-0.70	1.99	
	M	year before	284.57	10.32	29
		1999	284.25	12.13	29
Difference			0.32	-1.81	

Table 29. ANCOVA of A/B schools the year preceding implementation of block scheduling and 1999 with size as covariate and group/gender as main effects

Source of Variation		Df	Mean Squares	F	Sig of F
School Size	Reading	1	81.11	.532	.467
	Mathematics	1	0.36	.003	.959
	Social Studies	1	55.04	.327	.569
	Science	1	49.76	.289	.592
	Composite	1	24.41	.247	.620
Gender	Reading	1	5261.32	34.49	.000*
	Mathematics	1	224.33	1.642	.203
	Social Studies	1	1281.29	7.612	.007*
	Science	1	1540.91	8.943	.003*
	Composite	1	1869.22	18.895	.000*
Group	Reading	1	12.27	.080	.777
	Mathematics	1	60.12	.440	.509
	Social Studies	1	88.26	.524	.471
	Science	1	97.76	.567	.453
	Composite	1	0.55	.006	.940
Gender/Group	Reading	1	11.55	.076	.784
	Mathematics	1	31.31	.229	.633
	Social Studies	1	14.02	.083	.773
	Science	1	1.26	.007	.932
	Composite	1	7.16	.072	.788

*Significant at $p \leq .05$

Summary

In summary, this chapter has presented an analysis of Iowa Tests of Educational Development (ITED) data gathered from Iowa high schools using different scheduling interventions. One purpose was to report results of statistical tests calculated to determine if differences exist in student achievement, as measured by ITED scores, between Iowa high schools using a 4x4 block schedule, an A/B block schedule, and an 8-period day schedule. Statistical outcomes were analyzed comparing ITED Iowa state mean scores and mean scores of Iowa high school using a 4×4 or an A/B block schedule. Results also revealed whether differences exist between pre-implementation and 1999 ITED scores from Iowa high schools using a 4×4 block or an A/B block schedule. The next chapter presents the findings, conclusions, and recommendations for further research and practice.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this research was to determine whether a certain type of scheduling intervention – block scheduling – makes a difference in student achievement. The study examined the effects of scheduling modes on high school student achievement as measured by the Iowa Tests of Educational Development (ITED). Student performance, as measured by ITED scores, was used to compare 4×4 block-scheduled schools, A/B alternating-day block-scheduled schools, 8-period day scheduled schools, and the Iowa state norms. The battery of ITED scores used for comparison included reading, mathematics, science, social studies, and composite scores.

Summary

There has been a significant increase in the number of high schools implementing block scheduling during recent years. As school officials contemplate whether to switch from a traditional structure to a block format, they need to make an informed choice that is researched based, supported by studies using a quantitative methodology. The essential goal of block scheduling is not merely to improve the school and classroom environment and create a structure where both teachers and students have manageable workloads, but also to improve student achievement.

In Iowa, recent legislation has increased the need for high schools to utilize some form of standardized tests. All school districts are now required to submit a Comprehensive School Improvement Plan (CSIP) that outlines measurable goals and objectives to demonstrate improvement in student achievement. Two performance assessment instruments are required to be administered in grades 4, 8, and 11 that will measure growth in the content reading, mathematics, and science. One of the two must be a norm-referenced test. This has caused more and more Iowa high schools to administer the Iowa Tests of Educational Development (ITED) to satisfy this requirement.

Hackmann (1999a) identified all scheduling types used in Iowa high schools. From three of the scheduling types, samples were selected for this study: Fifteen 4×4 block-scheduled schools, 29 A/B block-scheduled schools, and 38 8-period day schools. To be included in the sample, the block schools needed to have been operating on a block structure for over two years. They also must have administered ITED during the 1999 school year and the school year prior to the conversion of a block-schedule.

Findings

The study sought to answer two research questions:

Research Question 1: What is the effect of block scheduling on academic student achievement in Iowa high schools as measured by the Iowa Tests of Educational Development (ITED)?

Research Question 2: Are these differences affected by the size of school and/or gender?

The findings of the research questions and hypotheses are presented based on the results obtained.

Research Question 1:

a. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an A/B block schedule?*

Research Question 2:

a. *Is there a significant difference controlling for size of school and/or gender?*

There was no significant difference in the performance on the ITED of 11th grade students in schools using either a 4×4 or an A/B block schedule. Factoring in school size and gender yielded the same conclusion. As a group A/B scheduled schools outperformed 4×4 schools in every category, although not significantly, except for science. In all areas, variability in test scores was greater in 4×4 schools than in A/B schools. Except in mathematics, females scored significantly higher on each of the five areas within each group. Average test scores for females in mathematics and social studies were higher in the schools using an A/B block-schedule, while 4×4 females scored higher in reading, science, and the composite. Male students in A/B block schools outperformed 4×4 block students in every ITED area, except for mathematics. The variability of the males' scores was greater than the females' scores in every case.

Hypothesis 1:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an A/B block schedule.*
b. *There is no significant difference controlling for size of school and/or gender?*

Although not statistically significant and except for a few isolated cases, A/B block-scheduled schools outperformed the 4×4 block-scheduled schools. The size of the school was not a factor. Controlling for gender yielded mixed insignificant results when comparing mean scores. Generally, the variability of scores was greater in the 4×4 block scheduled schools.

Research Question 1:

b. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Test of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an 8-period day schedule?*

Research Question 2:

b. *Is there a significant difference controlling for size of school and/or gender?*

There was no significant difference in the performance on the ITED of 11th grade students in schools using either a 4×4 or an 8-period day schedule. Factoring in school size yielded the same conclusion. Results were mixed when gender differences were included in the statistical testing. Although 8-period day schools significantly outperformed 4×4 schools in the categories of social studies and composite, there was no significant difference on reading, mathematics, or science scores. Factoring in the size of the school with gender yielded significant differences in the mean scores across both groups in every area with the exception of science. The larger schools produced significantly higher mean scores on the reading, mathematics, social studies, and composite tests. Eight-period day schools produced higher mean scores on all five tests, while the variability of 4×4 schools scores was greater in all cases. With the exception of mathematics, females significantly outperformed males in all categories. The spread in males' scores was larger than females' scores in every case except social studies scores in 8-period day schools.

Hypothesis 2:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and 11th grade students on an 8-period day schedule.*
b. *There is no significant difference controlling for size of school and/or gender.*

Factoring in the size of school, 8-period day scheduled schools outperformed the 4×4 block-scheduled schools, although not significantly. The variability of scores was greater in the 4×4 block scheduled schools. The size of the school was not a factor. When gender and size of school were both factored in, 8-period schools continued to outperform 4×4 schools and some of the differences were significant. In all but one case, larger schools performed better than smaller schools. Variability for males in 4×4 block schools was greater than for males in 8-period day schools. The opposite was true for females.

Research Question 1:

c. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and 11th grade students on an 8-period day schedule?*

Research Question 2:

c. *Is there a significant difference controlling for size of school and/or gender?*

There was no significant difference in the performance on the ITED of 11th grade students in schools using either an A/B or an 8-period day schedule. Factoring in school size and gender yielded the same conclusion with the exception of composite scores. There was a significant difference in the composite means scores. Although not significantly, 8-period day schools yielded higher mean scores in all tests and in all categories. Except for mathematics, females significantly outperformed males across both groups. The variability of test scores was greater in 8-period day scores with the exception of mathematics and female social studies. Variability of females' scores was less than males' scores in all areas.

Hypothesis 3:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and 11th grade students on an 8-period day schedule.*
b. *There is no significant difference controlling for size of school and/or gender.*

Although only one test result was significant, 8-period day scheduled schools outperformed the A/B block scheduled schools in every case. School size and gender were not factors. The variability of scores was mixed. Variability for males in A/B block schools was greater than for males in 8-period day schools. The opposite was true for females.

Research Question 1:

d. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and the Iowa state mean scores for 11th grade students?*

There was no significant difference in student performance in mathematics, reading, science, social studies, and the composite as measured by the 1999 mean scores on the ITED between 11th grade students on a 4×4 block schedule and the 1999 Iowa state mean scores for 11th grade students. The state mean scores were higher in all cases when compared with the 4×4 school mean scores. During the pre-implementation year, 36 scores of a possible 75 were above the state mean. In the 1999 testing period, 34 scores of a possible 75 were above the state mean.

Hypothesis 4: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and the Iowa state mean scores for 11th grade students.

Although not statistically significantly, the 1999 4×4 block school mean scores were lower than state mean scores in every area compared. Size of school and gender were not controlled for this hypothesis testing.

Research Question 1:

e. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and the Iowa state mean scores for 11th grade students?*

There was no significant difference in student performance in mathematics, reading, science, and social studies as measured by the 1999 mean scores on the ITED between 11th grade students on an A/B block-schedule and the 1999 Iowa state mean scores for 11th grade students. The difference in composite scores was statistically significant. The state mean scores were higher in all cases than the A/B school mean scores. During the pre-implementation year, 44 scores of a possible 145 were above the state mean. In the 1999 testing year, 52 scores of a possible 145 were above the state mean.

Hypothesis 5: There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on an A/B block schedule and the Iowa state mean for 11th grade students.

Although not statistically significant, the 1999 A/B block school mean scores were lower than state mean scores in every area compared. Size of school and gender were not controlled in the hypothesis testing.

Research Question 1:

- f. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11th grade students on a 4×4 block schedule and on 11th grade students in the same school before adoption of the block schedule?*

Research Question 2:

- f. *Is there a significant difference controlling for size of school and/or gender?*

There was no significant difference in student performance as measured by reading, mathematics, social studies, science, and the composite mean scores on the ITED between 11th grade students in 1999 on a 4×4 block-schedule and 11th grade students in the same school the year prior to the adoption of the block schedule. Factoring in the size of the school and gender also yielded no significant difference. For the ITED scores in reading, social studies, and the composite, females significantly outperformed males. There was no significant difference in performance between males and females in mathematics or science. Except for results in females' reading, social studies, and science, mean scores were higher in the pre-implementation year in all other categories. Variability was greater in 1999 than in the year prior to block scheduling in all test scores with the exception of females' science and composite scores.

Hypothesis 6:

a. *There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on a 4×4 block schedule and on 11^{th} grade students in the same school before adoption of the block schedule.*
b. *There is no significant difference controlling for size of school and/or gender?*

Factoring in the size of school, the mean scores in all cases were greater, although not statistically significant, in the year prior to the implementation of 4×4 block scheduling than during the 1999 year in the same school. School size was not a factor. When factoring in the size of school and gender, the results were mixed, with females in 1999 outperforming the pre-implementation females in three out of the five cases compared. These differences were not statistically significant. Generally, the variability of the 1999 scores was greater than the pre-implementation year scores.

Research Question 1:

g. *Is there a significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Tests of Educational Development between 11^{th} grade students on an A/B block schedule and on 11^{th} grade students before adoption of the block schedule in the same school?*

Research Question 2:

g. Is there a significant difference controlling for size of school and/or gender?

There was no significant difference in student performance as measure by reading, mathematics, social studies, science, and the composite mean scores on the ITED between 11th grade students in 1999 on an A/B block schedule and 11th grade students in the same school the year before the adoption of a block schedule. Factoring in the size of the school and gender also yielded no significant difference. In all areas other than mathematics, females significantly outperformed males. With the exception of male composite scores, 1999 A/B mean scores were higher than in the pre-implementation year in all categories. Variability was greater in the pre-implementation year scores than in the 1999 scores in all testing areas, except in male mathematics, social studies, science, and composite scores.

Hypothesis 7:

a. There is no significant difference in student performance in mathematics, reading, science, social studies, and their composite as measured by mean scores on the Iowa Test of Educational Development between 11th grade students on an A/B block schedule and on 11th grade students before adoption of the bloc -schedule in the same school.

b. There is no significant difference controlling for size of school and/or gender?

Although not statistically significant, the mean scores in all but one case were greater in the 1999 school than in the same school during the year prior to the conversion to an A/B block-schedule. School size and gender were not a factor. No conclusion can be drawn from observing the variability of the pre-implementation scores and 1999 scores. The results were mixed.

Discussion and Conclusions

This study suggests that there is no significant difference in student achievement as measured by the Iowa Tests of Educational Development in Iowa schools using either a 4×4 or an A/B block-schedule. Also, no significant difference was found when comparing students in schools using a traditional 8-period day schedule and students in either a 4×4 or an A/B block-scheduled school. These results support previously conducted research (Canady & Rettig, 1999; Morris, 1997; Shortt & Thayer, 1999; Veal & Schreiber, 1999; Whitfield, 1999; York, 1997). Although not significantly, A/B blocked schools consistently outperformed 4×4 block schools and 8-period day schools outperformed the block schools. Hamdy (1996) found similar results in portions of her study. This study contradicts Vawter's (1999) conclusion that 4×4 blocked schools produce the greatest gains in student performance.

One unique aspect of this study was the comparison of the ITED scores in the year prior to implementation of a block schedule with the 1999 ITED scores of the same school. Although the gains were not significant, this longitudinal component suggests that the ITED mean scores of schools will increase after the conversion to an A/B block schedule. The same results were not produced with a 4×4 schedule. With the Iowa legislative mandate that school districts provide evidence of improved student achievement, this is a significant conclusion for schools on a traditional schedule considering implementation of some form of block scheduling.

Another pattern that developed throughout the course of the hypothesis testing was that the variability of scores in the block schools was consistently greater than in the traditional scheduled schools. When factoring in gender, the range in standard deviations primarily was due to the wide differences in male mean scores. From this study, the differences in standard deviations between the groups on block scheduling indicate that males' scores had more variability than did females' scores. In the majority of cases, females' scores in block schools actually were grouped more tightly than females' scores in traditional scheduled schools. The goal would be that little, if any, difference in variability exists when the data are disaggregated by gender. This observation derived from this study, needs to be examined further. The focus of such a study should be on identifying gender bias in the curriculum and in teaching methodologies used with schools that are structured in a block format.

Very little research exists on the impact of block scheduling on student performance when disaggregating the data by gender. In this study, except for mathematics, females significantly outperformed males on the ITED and converting to a 4×4 or an A/B block-schedule had more of a positive effect on females' test scores than on males' test scores. This supports the findings of Rufino (1999). Although not significantly, the gap between mean scores of female students in 8-period day schools and female students' scores in A/B block schools was less in every case than the gap between the comparable scores for males. Overall, block scheduling seemed to have more of a positive effect on female test scores than on male test scores. This would be another positive benefit of block scheduling for schools that are experiencing lower scores for females when test results are disaggregated by gender. Hartzell (1999) notes in her study that females complete more homework and spend more time doing it. Under a block format a student has more time to concentrate on fewer subjects. One can hypothesize that the added emphasis on homework by females would pay additional dividends on student performance when using a block schedule.

In this study, the size of the school had little effect on student performance on the ITED, but there was a positive correlation between mean scores on the ITED and school size. As school size increased, the ITED mean scores rose. Except in one hypothesis test, comparing 4×4 block and 8-period day schools, these differences were not significant. This may suggest that, as schools get larger in size, the greater the breadth of the curriculum offerings, the fewer the number of assigned preparations per teacher, and the larger the amount of financial and human resources available. These factors may help explain the differences in student performance that were reflected in this study.

The Iowa Department of Education requires each school to report out on their Comprehensive School Improvement Plan student performance in reading mathematics and science. None of the results from the hypotheses testing for these three areas in this study was statistically significant.

Limitations

The study had the following limitations:

1. The staff development needed to prepare teachers to implement block scheduling was not studied. Another criteria for selection of a sample school to participate in this study could have been the amount of staff development administered before, during and after the implementation of block scheduling. This would have neutralized another independent variable.
2. The different types of instructional methods used in classroom that might contribute to increased standardized test scores were not studied. Teacher competencies still have the largest affect on student performance. Well-designed lessons needs to be

developed to utilize the potential for creating a constructivist classroom in a block schedule.

3. The small number of schools studied may not be representative of all schools in Iowa. Although, the comparison groups used in this study were found to be statistically equivalent.
4. Hypotheses 6 and 7 compared the 1999 performance of students in high schools using either a 4×4 block or an A/B block format with the student performance in the same high school the year prior to implementation of a block schedule. This study failed to identify the type of schedule these schools were functioning under during the pre-implementation year. There may be a difference in student achievement between schools converting to block scheduling from traditionally scheduled schools on either a 6-, 7-, or 8-period day.
5. The Iowa Test of Educational Development may not be completely aligned with the school district's curriculum and therefore may not be a totally valid measure of student achievement.
6. It is difficult to motivate 11th grade students to put forth maximum effort on standardized tests that are not counted as part of their current grade or tied to college entrance criteria. It students are not motivated to try their best on the ITED, their resulting scores would not be an accurate indicator of student achievement.

7. This causal-comparative method compared 11th grade students in one year with 11th grade students in a different year. The majority of the schools studied were relatively small in size. High school demographics can change quickly in a small district just by a few students moving in or out and/or any change in the source(s) of employment opportunities in a community.

Recommendations

Restructuring how time is allocated has the potential to cause systemic reform in a high school. Block scheduling is one schedule configuration that Cawelti (1994) identifies as a major catalyst for change. Current literature and existing research strongly supports the notion that block scheduling improves school climate, reduces the number of discipline referrals, reduces the number of courses a teacher teaches and a student attends in a given day, and can provide students the opportunity to accelerate or repeat a failed course.

Nevertheless, what is the effect of block scheduling on student performance? Canady and Rettig (1999) emphasize that "merely changing the school bell schedule will not guarantee better student performance" (p. 15). Canady and Rettig (1995) suggest that adopting a block schedule helps facilitate instructional innovations and implementation of desired instructional programs. Educational reform will result in a significant change in the way teachers and students interact. Block scheduling allows for the creation of a constructivist classroom. In a constructivist environment, learning emerges in the mind of the student from the real-world activities taking place in the classroom. Since learning is constructed from the student's own framework of personal experience, it will not easily be forgotten. It is in this creation of a rich learning environment that block scheduling has the potential to improve student performance. A standardized test may not reflect the depth of learning that results from a constructivist setting.

Many studies exist that support the idea that student grade point averages (GPA) will improve with a block format (Canady & Rettig, 1999, Edwards, 1995; Hampton, 1997; Sharman, 1990). GPA is not a good measure of achievement, since it is subject to subjective teacher bias when awarding grades to students. The purpose of this research study was to determine whether scheduling interventions make a difference in student achievement, as measured by a norm-referenced standardized test. Specifically, the focus of this research was to compare student performance, as measured by the Iowa Tests of Educational Development, of students in Iowa high schools using traditional and either a 4×4 or an A/B block schedule.

The debate of whether norm-referenced standardized tests are an accurate indicator of student learning and/or whether they should be used to compare student performance between different students, buildings, districts, and states is a moot point at this time. The Iowa legislature is mandating that all Iowa school districts report to their publics student performance data by means of at least one norm-referenced standardized testing instrument.

Recommendations for practice

Following an analysis of the existing research and the results of this study, the following recommendations for practice are suggested:

1. Iowa school districts using a traditional high school schedule should convert to an A/B block schedule sprinkled with a very limited number of half-blocks for specific

electives such as typing. After a minimum of 3-5 successful years on this schedule, they should consider implementing a 4×4 block schedule.

2. Before implementation of a block schedule, school districts should take the necessary steps to prepare for the change. These steps must include a needs analysis, an extensive review of existing literature and research, curriculum revision, staff development, communication with all stakeholders, and an evaluation process.
3. Teachers should be provided ongoing staff development after the conversion. Focus the teacher training on the development of lesson designs that can be utilized in a constructivist classroom.
4. For the high schools that are administering the Iowa Tests of Educational Development, a careful item analysis should be completed to ensure ITED content is embedded in the existing curriculum.
5. Schools need to find ways to motivate 11^{th} grade student to put forth effort when taking the ITED.
6. Iowa Code requires the results of two assessment measures to be reported to the educational community. Only one needs to be a norm-referenced test. The alternate assessment instrument should be selected and/or created to measure authentic, real-world learning that exemplifies constructivist learning.

Recommendations for further research

This investigation focused on student achievement, as measured by the Iowa Tests of Educational Development (ITED), in schools that have adapted a 4×4 or an A/B block schedule. As the popularity of block scheduling continues to increase in Iowa, the amount of longitudinal data available will grow and more research studies will be conducted. The significant findings of this research suggest further study is warranted, along the following lines:

1. Survey the block schools to find out the breadth and depth of the staff development that was used to prepare staff for the conversion from a traditional schedule to a block schedule. Are the staff development activities used ongoing? Does the amount of staff development provided correlate positively with the success of the conversion and with improvement in achievement?
2. Replicate the study involving more schools and over longer periods of time.
3. Compare and contrast student performance trends over the course of time that a school is on a block schedule. Conduct some year-by-year comparisons. For example, does performance improve or decline the years immediately following the implementation of a block schedule? What are the trends after one, three, five, or more years of implementation?
4. Study the conversion process used by schools to implement block scheduling. Correlate the process with success factors of the implementation.
5. Investigate the reasons why the schools converted from a traditional schedule to a block-schedule.
6. Both 4×4 and A/B block schedules enable a high school to offer the equivalent number of course offerings as an 8-period day schedule. Conduct similar research on schools that have converted from a 6- or 7-period day schedule to a block schedule.
7. Conduct similar research and disaggregate student performance data by socio-economic status.

8. Replicate the study using Advanced Placement (AP) tests, Student Achievement Test (SAT), and/or American College Test (ACT).
9. Investigate, using qualitative methodology, schools that have implemented various combinations of a block and traditional schedule. What curriculum areas are blocked and which are not? What criteria determined whether a course was offered in block format or a traditional setting?
10. Investigate the reasons for the differences in the range of standard deviation values between males and females.

In summary, the findings of this study added to the body of knowledge that there is no significant difference in student achievement, as measured by a standardized test, between high schools that are using a block schedule and high schools that are using a traditional schedule. This conclusion, although statistically insignificant, is educationally significant. Iowa school administrators can restructure time in the school day by converting from a traditional 6-, 7-, or 8-period day to a block schedule, taking full advantage of all the benefits associated with the implementation. These include improvements in school climate, more manageable student/teacher workloads, potential for the creation of a constructivist classroom, and improvements in student grade point averages. School leaders can make this conversion based on what is in the best interest of their students, without worrying about its impact on standardized test scores mandated by state legislation.

APPENDIX: COMMUNICATION

Letter Sent to Participating Schools

September 1, 2000

«Title» «FN» «LN»
«School»
«Address»
«CityState» «Zip»

Dear «Title» «LN»,

I hope your school year has started off well. I am the Director of Human Resources/Technology for the Newton Community School District. I am also a Ph.D. candidate at Iowa State University.

My dissertation topic is a comparison study of the scores on the Iowa Tests of Educational Development (ITED) of 11th grade students. I have selected your school district for my study because your high school utilizes a block schedule or an eight-period day schedule. I will compare the ITED mean scores of all the high schools in Iowa using block scheduling and a random sample of high schools using an eight-period day schedule. I will compare performance, as measured by ITED scores, of 4 x 4 block-scheduled schools, alternating-day block-scheduled schools, and eight-period day scheduled schools. Approximately 100 schools will be used in my study and it will be a double-blind study. The school will be the unit of analysis and not the individual student. I have submitted a list of the schools to be used in my study to the ITED Center in Iowa City. They will gather all of the needed data and will report to me the mean scores in mathematics, reading, science, social studies, and the composite scores for each school. I <u>will not</u> know the names of the schools included in each data set. I will only be told in which category they belong. For example, I will be told that School A is either a 4 x 4 block-scheduled school, an alternating day block-scheduled school, or eight-period day scheduled school, but I <u>will not</u> know the name of School A.

School enrollment is a critical component when doing my statistical analysis. The ITED Center will not release enrollment information without prior authorization. I am asking your permission for the ITED Center to release the enrollment of your high school (not the name) when they send me data. After the data has been analyzed, I will select a small sample of block-scheduled schools to interview regarding which factors may have contributed to the ITED scores. If selected, I will need your permission to interview one of your school officials. The ITED Center will then release to me the names of those schools I wish to interview. I <u>will not</u> use the name of those schools in my dissertation.

I know you are extremely busy finalizing your Comprehensive School Improvement Plan. As you are well aware, Chapter 12 legislation is asking you to report out student performance scores using at least two assessment measures. One measure is the use of a standardized test. Many schools will be using the ITED scores as this measure. Will student performance, as measured by scores on the ITED, improve, decline, or remain the same, if a school would switch to block scheduling? My hope is that my dissertation will shed some light on the answer to this question.

Enclosed is a stamped postcard for you to fill out and return to me. I thank you in advance for your timely response in returning this post card. Receiving your authorization to release enrollment size is a key component for completing my dissertation. I will send you the results of my study upon its completion.

Sincerely,

Jim Pedersen
1006 W. 15th St. S.
Newton, Iowa 50208
H (641) 792-7636
E-mail: Pedersen_jim@mail1.newton.k12.ia.us

Contents of Postcard Sent to Participating Schools

I, Superintendent of Schools, give ITED Center permission to release the size of my high school to Jim Pedersen for the sole purpose of educational research needed for his dissertation. I understand that the school name will not be given to or used by Jim Pedersen in his dissertation. I understand that if selected as a block school to be interviewed, after completion of the study, the ITED Center can release the name of my school. Again, the name of my school will not be used in the dissertation.

Signed

______________________________, Superintendent of Schools
(name)

______________________________ Community School District
(name)

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