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The impact of block scheduling on student performance on the Virginia Standards of Learning End-of-Course assessments

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THE IMPACT OF BLOCK SCHEDULING ON STUDENT PERFORMANCE ON THE VIRGINIA STANDARDS OF LEARNING END-OF-COURSE ASSESSMENTS

A Dissertation

Presented to

The Faculty of the School of Education

The College of William and Mary

In Partial Completion

Of the Requirements for the Degree

Doctor of Philosophy

By

James Kenneth Richardson

April 2000

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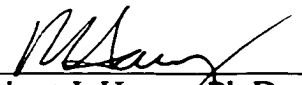
Approved April 2000



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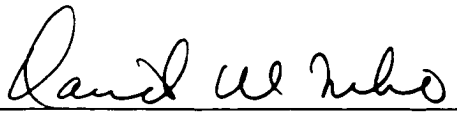

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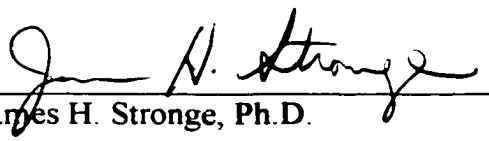

James H. Stronge, Ph.D.

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To my wife, Renee, without whose love, support, humor, encouragement, understanding, and sacrifices this dissertation could not have been completed.

To my parents, Arthur and Elizabeth, who instilled in me the love of learning, the drive, and the work ethic without which this would not have been possible.

To my in-laws, Richard and Glenda, who have encouraged me since I began this undertaking.

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The efforts and/or encouragement of the following individuals warrants formal recognition. They include:

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ABSTRACT

The purpose of this study was to assess the impact of alternative scheduling models (4X4-semester block, alternate day (A/B) block, and traditional six- or seven-class period day) on high school students' performance on Virginia's Standards of Learning (SOL) End-of-Course assessments. The study also focused on whether student performance was impacted by an interaction of scheduling model and school community.

The researcher used data identifying the percentage of students passing and mean scaled scores for students taking the assessments during the 1998-1999 school year at Virginia's 289 public high schools. Three (criterion-referenced) tests each were administered in mathematics, social studies, and science.

The results of a 3X3 analysis of variance (ANOVA) conducted on each of the 18 test measures revealed significant differences ($p<.05$) in the main effects for scheduling model. In 13 of the 18 measures, schools using 4X4 block underperformed schools using A/B block and traditional models. In three of the remaining measures, 4X4 schools underperformed only traditionally scheduled schools, (on two of these, A/B schools also underperformed traditionally scheduled schools).

Additionally, significant interactions ($p<.05$) between scheduling model and school community were revealed for 11 of the 18 measures. In each case where a difference was noted, 4X4 schools in urban communities underperformed schools in all

or some of the other subgroups. 4X4 schools in rural communities scored lower than one or more other subgroups on two of the test measures, as did A/B schools in rural communities.

One important implication drawn from this study relates to the testing schedule used. Schools using 4X4 block scheduling must administer the SOL tests much earlier in the course than schools using other models, potentially putting students at a disadvantage. The researcher recommends administering the tests closer to the end of the course.

The researcher further advises decision-maker in Virginia and other states using high stakes testing to carefully monitor the performance of their schools on end-of-course testing. While the results of this study may not be typical, and that other states or subsequent testing years will not show similar differences, the results do not bode well for schools using 4X4 scheduling.

JAMES KENNETH RICHARDSON

PROGRAM IN EDUCATIONAL POLICY, PLANNING, AND LEADERSHIP

THE COLLEGE OF WILLIAM AND MARY IN VIRGINIA

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CHAPTER 1

INTRODUCTION

Since at least 1983, when *A Nation at Risk* (National Commission on Excellence in Education, 1983) shocked the country into mobilizing to improve public education, a great deal of attention has been focused on the quality of the education being provided America's youth. The National Commission on Excellence in Education (1983) and the other blue ribbon panels following it raised the level of concern among both the educational and the larger communities. American schools were, the reports asserted, producing graduates who were often functionally illiterate, unprepared for the work force, underprepared for higher education, and lacking in basic skills, among other criticisms.

Some of the reports called for various changes to the curriculum. These include the politically popular "back to basics" movement (National Commission, 1983), or enforcing more rigorous standards on the existing curriculum (National Commission, 1983). Others called for changes in the way teachers and administrators are trained (Adler, 1982; Boyer, 1983; Goodlad, 1984; Task Force on Teaching as a Profession, 1986). Still others insisted that the structure of American public schools must change. The more popular calls for structural change included recommendations that schools be, alternately, more student-centered, more democratically governed, or more accountable to society.

Reform efforts also focused on improving the instructional strategies used by teachers (National Commission, 1983). Research has focused upon the effects of various teaching strategies on student achievement. Goodlad (1984) and Wyatt (1996) have

asserted that promising models include those that promote active student participation, vary activities over the course of the instructional period, accommodate Gardner's multiple-intelligences theory, use cooperative learning structures, make more authentic assessment of student progress, and promote mastery learning.

Until the early and mid-1990s, few reformers suggested that one of the problems hindering effective implementation of reform was the rigidity of the daily school schedule. As recently as 1992, 96% of all high schools in America were on either a six- or seven-class period school day, with teachers responsible for as many as six classes each day (Office of Program Evaluation, 1996). Since that time, more and more teachers and school leaders have decided that meaningful change may not be possible using the traditional school schedule.

In 1993, Donahoe pointed out that time is necessary to promote the collegial activities necessary for effective school change. She noted that "like a factory – but unlike most other organizations – a school doesn't have much flexibility for structuring into the schedule the kind of time that teachers need to make schools a collegial effort" (p. 300). This idea was mirrored by Sommerfield (1993), who asserted that "greater collaboration and decision-making among the adults in a school building, as well as the use of schools to train future teachers, conduct research, and serve broader societal needs . . . cry out for a re-examination of how time and space are structured" (p. 14). She added "as the call goes out for all students to engage in higher-order thinking and to learn how to learn through hands-on activities and teamwork, the use of time and space in schools must be reconfigured" (p. 14).

The voices of Donahoe (1993) and Sommerfield (1993) appeared to echo more loudly in 1994, when Anderson wrote "attention to time issues has increased with the establishment of the national goals and the concomitant efforts to establish curriculum frameworks, new assessments, and standards for all students" (p. 8). Anderson also reminded his audience that the issue of time was addressed in *A Nation at Risk*, but had been largely ignored. "Of all the recommendations made in *A Nation at Risk*," Anderson asserted, "the Commission's suggestion regarding the use of time probably has received the least attention" (p. 8).

Also in 1994, Treadway (1994) noted another reason for rescheduling the school day – the increased graduation requirements placed on students in several states. Under the traditional six- or seven-class period schedule, Treadway pointed out, students are often left little or no room for electives (see also Rettig & Canady, 1996). Using alternative scheduling may allow students more room in their schedules to enroll in elective classes.

Finally, in 1996, the National Association of Secondary School Principals (NASSP), in conjunction with the Carnegie Foundation, published *Breaking Ranks: Changing an American Institution*. This report represented one of the first examples of a national organization of educational practitioners endorsing the idea of restructuring the school day. Among the more broad-reaching proclamations to appear in this report is the following:

> Teaching and learning need more room for flexibility. High schools must abandon or revise the Carnegie unit so that *they no longer equate seat time with learning*. Furthermore, schools should operate 12 months a year and

> *full-time teachers should not be responsible for more than 90 students a term so that they can give more attention to individual students* [italics added]. (p. 5)

The NASSP argued that "[s]tudents benefit when their teachers are not burdened with an oppressive workload . . . A teacher carrying too heavy a student load cannot readily find time for such vital activities as advising, curriculum writing, instructional preparation, and professional development" (p. 47).

Several ways to restructure time in high schools have been discussed, including year-round schools, six-day weeks, and longer school days. By and large, these three proposals are unacceptable to American public education for a number of economic, political, and cultural reasons. An alternative time structure that has achieved some degree of broad acceptance, block scheduling and its various derivatives, does not attempt to change the school-year calendar, and affect the length of the school day only slightly, if at all. By 1995, approximately 40% of the nation's high schools had adopted some form of block scheduling in an attempt to improve teaching and learning.

Statement of the Problem

This study investigated the effect of alternative day (A-B) and 4X4 semester block scheduling on high school students' performance on the Virginia Standards of Learning end-of-course assessments. The study further examined interaction effects of urbanicity and block scheduling on the students' scores and pass rates.

The following questions served as a framework for the study:

1. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4

semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method, the traditional six-class period day, and/or the traditional seven-period day scheduling models?

2. Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using alternate day (A/B) block scheduling, the traditional six-class period day, and/or the traditional seven-period day?
3. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?
4. Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?

Need for the Study

Across the nation, and especially in the Commonwealth of Virginia, more and more high schools are abandoning traditional scheduling models in favor of block scheduling models. In its evaluation study of the implementation of block scheduling at Western Branch High School, the Chesapeake (Virginia) Public Schools reported that "in 1992, ninety-six percent of the high schools nationwide and ninety-eight percent of Virginia's senior high schools were scheduled using a traditional, six-period day (Kasonovic, 1992), [but that] by 1995 . . . over forty percent of the high schools nationwide and forty-six percent of the schools in Virginia were using some form of

block scheduling" (Hackman, 1995; O'Neill, 1995, in Office of Program Evaluation, 1996, p. 2). By the 1998-1999 school year, the number of Virginia high schools using some form of block scheduling had risen to just over 67% (Rettig, 1998).

There is general agreement in the literature that block scheduling can have a positive impact on school climate, provide teachers the opportunity to improve and expand their instructional strategies, reduce discipline problems, improve attendance, and foster critical thinking skills (Canady, 1990; Canady & Rettig, 1993; Rettig & Canady, 1996). There have been few studies to date, however, that have objectively addressed the effects of block scheduling on student learning, except as measured by teacher-assigned grades or attitudinal scales; a few have also looked at the relationship between the scheduling model used and AP test scores and the schedule and achievement in an isolated content area.

By addressing the impact of block scheduling on student learning and by assessing possible interaction effects of urbanicity, the findings of this study will provide important data that may be used by school leaders when considering adopting or abandoning block scheduling models.

Assumptive Framework

A body of research has asserted that most students learn and retain information more effectively when they are in small classes (Schoenstein, 1994, 1995; Wilson, 1995) where their teachers are able to get to know them well enough to individualize their instructional programs. At schools using traditional scheduling models, individualizing instruction is very difficult, if not impossible, for most high school teachers, who are

often responsible for 120 or more students spread out over at least five classes (which often encompass as many as three or four preparations).

Proponents of block scheduling claim that, by giving dedicated teachers an opportunity to teach the same students for longer class periods, and to teach fewer classes and preparations each day, teachers will be able to add more effective instructional strategies to their repertoires. Additionally, by spending more time with fewer students, teachers will have greater opportunities to get to know their students and their learning styles and needs more fully. This, it is asserted, will enable teachers to individualize their instructional strategies leading to improved student academic achievement.

Block scheduling is designed to allow for each of these goals. Implemented appropriately, block scheduling models decrease the numbers of classes that students take, and that teachers teach, each day. It may also encourage teachers to develop a variety of instructional methods, which research asserts improves student engagement, learning, and retention. Proponents claim that block scheduling can also be expected to positively affect the degree to which teachers are able to individualize instruction.

However, little research has addressed whether block scheduling models actually improve student (academic) achievement beyond students' grades, retention, and graduation rates. We do not know whether, or to what extent, block scheduling models lead to improvement on norm-referenced tests of student achievement. Nor do we know authoritatively whether there are significant differences in the magnitude of the benefits offered by block scheduling models.

Operational Definitions

Alternative Day (A/B) Block – The Alternate Day (A/B) block scheduling model uses an instructional day consisting of three or four class periods of 90-120 minutes each. In this model, students are enrolled in six to eight courses, each of which meets every other day. It takes an entire academic year to complete a one-credit course (Canady & Rettig, 1996; Huff, 1995; Ziemke, 1994).

Block Scheduling – Block scheduling refers to any of a number of alternative scheduling models designed to increase the length of the class period beyond the traditional 45-55 minutes used in schools using traditional six- or seven-class period school days. The more common models include: alternate day (A/B) block, Copernican scheduling, 4X4 semester block (4X4), and intensive scheduling (Canady & Rettig, 1996).

Four-by-Four (4 X 4) Semester Block Scheduling – In this model, students are enrolled in four classes per semester. Each class meets for approximately 90 minutes each day, and a full credit is earned in one semester. Variations allowing for performance music classes to run the entire year for 45-minute class periods are common (Aguilera, 1996; Averett, 1994; Canady & Rettig, 1996; Clauson, 1994; Frost, 1993; Gerking, 1995; Schoenstein, 1994; Wilson, 1995).

Student Achievement – In this study, student achievement will be objectively measured based upon student scores on the Virginia Standards of Learning end-of-course assessments in Algebra I, Algebra II, Geometry, Earth Science, Biology, Chemistry, U. S. History, World History to 1000 A.D./World Geography (World History A), and World History from 1000 A.D./World Geography (World History B). Teacher-generated and -assigned scores will not be considered.

Traditional Six- or Seven-Class Period Scheduling – In the traditional six- or seven-class period schedule, students are enrolled in six or seven classes at a time, each of which meets every day. It takes one academic semester to receive ½ credit in a semester course, or an entire academic year to receive a full credit. Classes may last for either one semester or an entire academic year.

Urbanicity – The Virginia Department of Education provided the researcher with a document labeling most of the high schools in the Commonwealth as either "U" (urban), "S" (suburban), or "R" (rural). The same document identifies 15 "central cities" in the Commonwealth. The researcher has accepted the judgment of the Department of Education in identifying the school community of each of these schools. In cases where individual schools were not identified using these labels, the researcher adopted the label given by the Department of Education for other schools within the same school division.

Limitations of the Study

Several factors and variables are beyond the control of the researcher and may affect the results and any interpretaions of those results. These include:

1. Different schools have adopted different variants of block scheduling.
2. The processes used in adopting scheduling models are not similar and may have an effect on implementation.
3. Teachers use different strategies in all scheduling models.
4. The amount and quality of staff development and other training used to prepare teachers to implement longer class periods varies from site to site.
5. There are certain problems inherent in the definitions related to urbanicity. and

6. No attempt was made to control for initial differences in the abilities, socioeconomic status, family background, etc., of the students attending the schools included in this study.

Delimitations of the Study

The researcher delimited the study in the following way:

In order to compare student performance on similar measures, (i.e., the Virginia Standards of Learning tests), only Virginia high schools were selected; therefore, the selection of schools is limited.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

In reviewing the literature on block scheduling, frequent references were found to three main models used when implementing alternatives to the traditional six- or seven-bell high school schedule. These were intensive scheduling, alternate day (A/B) block scheduling, and 4X4 block scheduling. This chapter will summarize and discuss the research on each of these models, especially as they impact on school climate, instructional issues, and student achievement.

Block Scheduling

According to Carroll (1990), block scheduling is "about the relationship between time and learning" (p. 26). It is surely among the fastest growing innovations in public high schools. In its evaluation of 4X4 semester block scheduling at Western Branch High School, the Chesapeake (Virginia) Public Schools reported that "in 1992, ninety-six percent of the high schools nationwide and ninety-eight percent of Virginia's senior high schools were scheduled using a traditional, six-period day (Kasonovic, 1992), [but that] by 1995 . . . over forty percent of the high schools nationwide and forty-six percent of the schools in Virginia were using some form of block scheduling" (Hackman, 1995; O'Neill, 1995, in Office of Program Evaluation 1996, p. 2). In the 1999-2000 school year, 68.0% of Virginia's high schools used some form of block scheduling (Rettig, 1999).

School leaders have offered many reasons for making the change to the block scheduling models. Some of these address purely academic reasons. Arguments include:

attempting to reduce high failure rates (Edwards, 1993), refocusing on the core curriculum (Wilson, 1995), increasing students' focus to fewer courses at a time (Clauson, 1994; Schoenstein, 1994, 1995), providing longer blocks of time to increase coverage (Wilson, 1995), and, simply, expanding student learning (Averett, 1994; Rettig, 1999).

An additional rationale for block scheduling is to improve teaching practices by: decreasing class size (Schoenstein, 1994, 1995; Wilson, 1995), shrinking the student-teacher ratio (Schoenstein, 1944, 1995), increasing teacher planning time (Clauson, 1994), and encouraging teachers to use more variety and hands-on teaching/learning techniques (Clauson, 1994; Wilson, 1995). Edwards (1993) pointed out that "[I]f students and teachers worked with fewer classes and fewer people each day, they could focus more time and energy on improving instruction and increasing learning" (p. 78).

A third theme to appear in the rationale for block scheduling might be identified as school or interpersonal climate. Those who claim that block scheduling will improve the interpersonal dimensions of the school focus on both student and teacher satisfaction. Some proponents have claimed that smaller classes, longer class periods, and fewer classes at a time (for both students and teachers) can be expected to reduce the level of impersonality in the school and classrooms (Ever thought . . .,1994; Wilson, 1995). Clauson (1994) took this argument a step further, suggesting that the adoption of such a model will both improve student-teacher relationships and decrease student and staff stress.

Among the many variations on block scheduling models, the three that appear most prominently in the literature are the intensive, alternate-day (A/B) block, and 4X4

semester block schedules. These models will be reviewed in the following sections of this chapter.

Intensive Scheduling

According to Andersen (1982), "intensive scheduling . . . would involve scheduling students into one class at a time, usually for three or four hours each day, for approximately four or five weeks" (p. 26). In addition, students would also enroll in an activity course, such as band or physical education each day, but for a shorter period of time each day. At the end of each term, the student will have completed the intensively scheduled class(es) and begin (a) new one(s).

Perhaps the most well-documented type of intensive schedule is the Copernican Plan, which was developed by Joseph M. Carroll and designed for use in a 180-day school year. Although Carroll (1994a) wrote that "the Copernican Plan is not about 'block scheduling'" (p. 26), a comparison of the Copernican Plan with the other common forms of block scheduling (intensive, 4X4, and A/B) suggests that the models differ more in degree than in substance.

This model has been fully implemented at Masconomet Regional High School in Topsfield, Massachusetts (Traverso, 1991). As Carroll (1990) describes his model, it is very different from the traditional six- or seven- class period day found at many high schools:

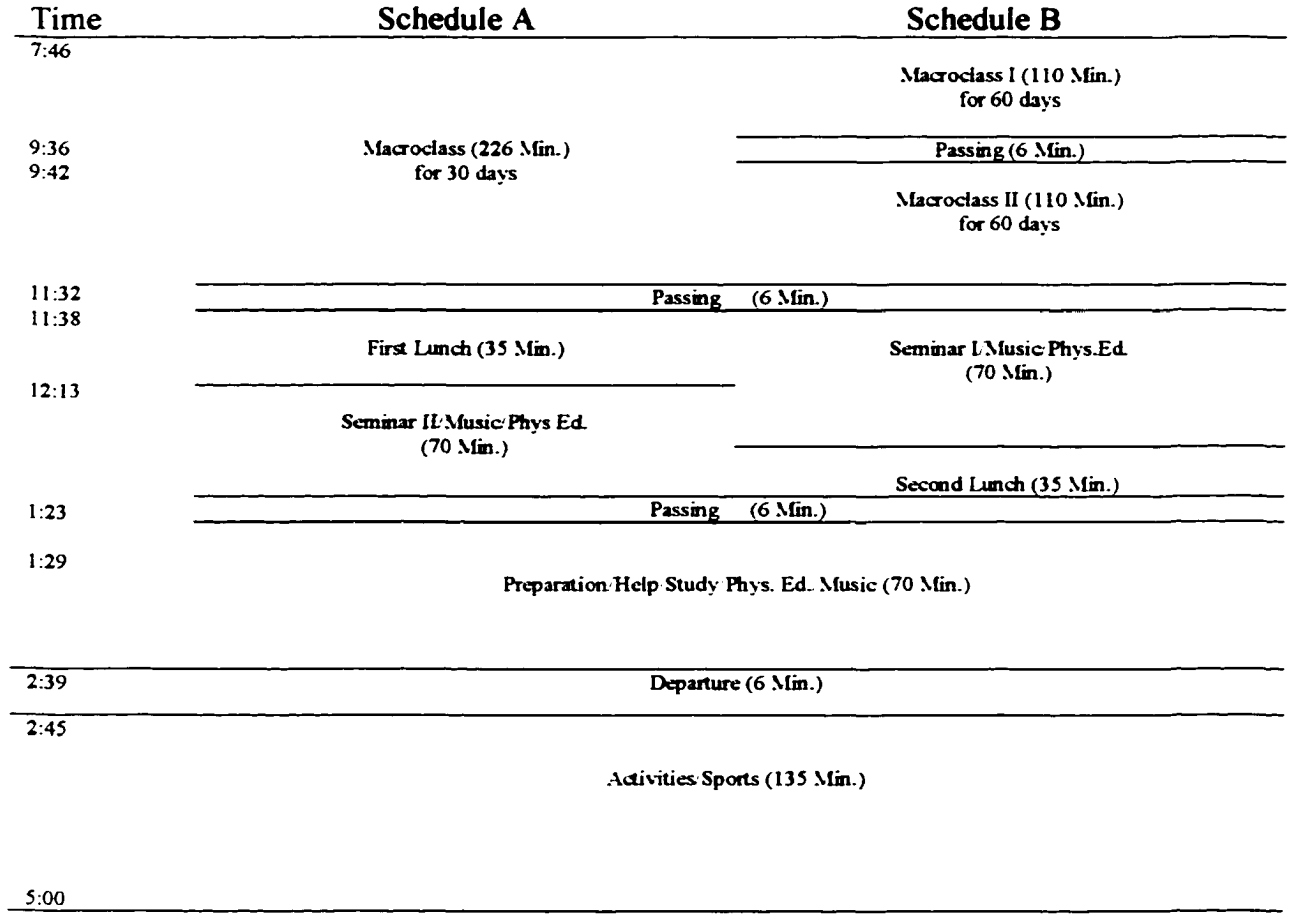
> Instead of having students change locations, subjects, and activities seven to nine times each day, [schools using the Copernican Model] ask them to concentrate on one or two subjects at a time, each taught in an extended "macroclass." This change allows high school teachers to concentrate on the learning of individual

> students, which is the key to better instruction and improved student performance. (p. 358)

If a student enrolls in only one "macroclass" during an academic term, that class meets for 226 minutes each day for 30 days; when the student enrolls in two "macroclasses," the time spent in each class is reduced to 110 minutes, but the term lasts for 60 days. In later articles, Carroll included the possibility of students taking four 90-minute classes for an entire semester (Carroll, 1994a, 1994b), foreshadowing 4X4 semester block scheduling. This model is more akin to the block scheduling models to be discussed later in this chapter.

In addition to the blocks of time during which students are engaged in their academic class(es) each term, they would also have the opportunity to enroll in a 70-minute seminar designed to use an interdisciplinary approach to explore complex issues of interest to the students (Carroll, 1990). The remaining two hours of the school day are set aside for a 35-minute lunch, a 70-minute "Preparation/Help/Study/Phys. Ed./Music" period, and time to allow students to move from one activity to another. A graphic description of two possible student schedules using the Copernican plan appears in Figure 1, Two Proposed Schedules for the Copernican plan.

Figure 1. Two proposed schedules for the Copernican plan.



(Carroll, 1990, p. 361)

In addition to changing the structure of the school day, the Copernican plan also restructures how grades and diplomas are assigned. The academic macroclasses are graded based on mastery of the course content. A student may earn as many as 10 credits per course, based on the percentage of the course objectives mastered. For example, if only 85% of the objectives are mastered, 8.5 credits would be awarded; if the student mastered all of the objectives, he or she would earn the full 10 credits. In the seminar and interest classes, students would receive "I-credits" based on their "attendance, participation, and attitude rather than for Mastery or for passing examinations" (Carroll, 1990, p. 364). Five different diplomas are available, based primarily upon the total

number of academic and I-credits earned. The familiar Carnegie credit units are not used in Carroll's model.

Variations on the Copernican plan have been used in several districts in the United States and Canada. One variation can be seen in New Haven, Connecticut's, High School in the Community program, where, in addition to a 90-minute course that meets for one nine-week grading period, students also take two 50-minute classes that meet for a semester at a time (Traverso, 1991). Another program similar to that described by Carroll may be found at Virginia's Fork Union Military Academy. At Fork Union, students take only one academic subject at a time, completing a course every 36 days. Students at Fork Union may also be enrolled in Health and Religious Studies, which are offered using a traditional 50-minute period (Traverso, 1991).

Advantages and Concerns Arising from Adoption of Intensive Scheduling Models

Proponents of the Copernican and other intensive scheduling models have asserted that adoption of the plan results in several positive outcomes. The advantages and concerns arising from the adoption of this, as well as the other block scheduling models to be considered, fall into three general themes: school climate, instruction, and student outcomes.

School climate. Supporters of intensive scheduling often claim that one potential advantage of the the smaller, longer classes made possible by intensive scheduling is an expected improvement in the school's interpersonal climate (Ryan, 1991). Supporters claim that taking fewer classes provides the opportunity for students to create deeper and more emotionally satisfying relationships with both their classmates and teachers (Andersen, 1982). Andersen (1982) pointed out that "it is expected that there would be

more meaningful student-teacher interaction . . ." (p. 26) and further suggests that only having one class of 20-30 students will allow teachers to better individualize instruction and involve all students.

The improvement in school climate under intensive models is also clear from reports from teachers, parents, and students, who generally report satisfaction in schools using the models (Alam & Seick, 1994; Carroll, 1994b). Alam and Seick (1994) reported that when an intensive scheduling model was implemented at Parker Junior High School in Colorado, it was difficult to find any teacher, student, or parent who was unhappy with any aspect of the program. It is important to note, however, that the Intensive Core Program at Parker Junior High School was an "opt-in" program for both students and teachers; their self-reports of satisfaction should, therefore, be viewed with this in mind. When an intensive model was studied at Masconomet Regional High School, Carroll (1994b) reported that outside evaluators from Harvard University determined that students in the program "were better known by their teachers, were responded to with more care, . . .[and] enjoyed their classes more" (p. 108)

Instructional implications. Among the most widely asserted (and potentially significant) advantages of intensive scheduling models are claims that instruction has improved as a result of the longer class periods. For example, Andersen (1982) asserted that teachers would be forced to expand their repertoire in order to hold their students' attention and motivation for longer periods of time. He did not, however, provide data to support his claim. Wyatt (1996) asserted that teachers must expand their strategies to be able to:

- encourage active student participation;

- incorporate a minimum of three activities per blocked class;
- accommodate Gardner's Multiple Intelligences Theory;
- use cooperative learning strategies;
- adopt mastery learning methods; and,
- develop effective curriculum maps and pacing guides.

Proponents of intensive scheduling argued that these instructional methods have been adopted (Andersen, 1982). Andersen (1982) also asserted that the longer planning time incorporated into the teachers' day allows them increased opportunities to pursue professional development opportunities. He further argued that hands-on instructional techniques, such as field trips, are facilitated in the intensive scheduling model, because the trips can be planned without the worry of pulling students from other academic classes.

Carroll (1990) also pointed out that the additional class and planning time available under the intensive scheduling model provides increased opportunities for teachers to implement more effective teaching strategies, "change [to the Copernican schedule] allows high school teachers to concentrate on the learning of individual students, which is the key to better instruction and improved student performance" (p. 358). He further asserted that the longer period of time spent with each class would allow teachers to get to know each of their students better, and to assess and address their specific learning needs. Furthermore, the increased time allows the teacher adequate opportunity to assess each student's mastery of the course content and objectives. While there is general agreement that intensive scheduling is at its best when teachers use the

additional time in ways described above, there is little empirical evidence to show whether these theoretical advantages are actually realized.

Student Outcomes. It can be argued that none of the advantages of any educational endeavor are important unless they result in improved student achievement. The empirical evidence of student achievement using intensive scheduling models is mixed, and focuses on two broad categories of student outcomes, nonacademic and academic.

Nonacademic outcomes of intensive scheduling models were assessed in a study of seven high schools using the Copernican plan in the United States and Canada. It should be noted that, among the seven schools in the study, six variants of the Copernican plan were used. The study, conducted by Harvard University researchers, indicated statistically significant reductions in suspensions and dropout rates, and modest improvements in attendance (Carroll, 1994b). Of the five high schools that reported suspension data, four reported reductions in the rate of suspensions by between 25% to 75% after switching to the Copernican scheduling model. Dropout rates also decreased at six of the seven schools, for an average 36% reduction across the schools (Carroll, 1994b).

The same study (Carroll, 1994b) addressed the academic impact of the Copernican plans. Academic progress was measured in terms of teacher-assigned grades and the number of courses completed. The study defined academic progress in terms of teacher-assigned grades and scores, not normed or criterion referenced tests. The schools in the study claimed "increases in academic mastery ranged from 0% to 46%" (p. 112).

Much of the remaining literature on intensive scheduling also suggests that gains in student academic achievement may be expected; the literature generally does not, however, quantify these gains. The improvement was attributed to improvements in instruction and the opportunity for students to put their entire focus on one or two courses at a time, rather than dealing with the conflicting requirements of five or six courses as is the case for students enrolled at schools using traditional scheduling models (Andersen, 1982; Ryan, 1991). It should be noted, however, that the reasons given for improved performance have not been tested using research models, and that they represent professional judgments by the authors.

At Parker Junior High/Middle School in Colorado, eighth-grade students involved in the Intensive Core Program (ICP) were enrolled in one intensive course along with three electives for 4 ½ week periods. In the evaluation of the program, students, parents, and teachers all reported that they believe the program worked well. Although no statistics were given, Alam and Seick (1994) reported that the grades of students enrolled in the ICP were dramatically improved. While improved grades can occur for any number of reasons, in this case "teachers believed that their standards were the same as in the past, but students who took teacher-made tests that had been used in previous years did better under the ICP model" (Alam & Seick, 1994, p. 733). It is important to note that, in this case, enrollment in the ICP program was voluntary; the positive results could, therefore, be a function of the type of students, parents, and teachers, who elected to become involved in the program.

Evaluations of academic achievement in schools using Copernican plans appeared mixed. In 1990, Carroll asserted that the use of the model "get(s) students to master 25%

to 30% more information . . ." (p. 358). However, it was not clear how or where he gathered his data.

An evaluation study of the Copernican plan at Masconomet High School found that both students and teachers involved in the program found it rewarding (Carroll, 1994b). The study, which compared student learning in the Copernican Program and the traditional program operating at the same school, found no significant differences between the two, although the students in the Copernican plan began with slightly lower reading and math scores than their peers in the traditional program (Carroll, 1994b). Similarly, no significant differences were found between students in the Copernican and traditional programs when retention was examined. In an oral test "assessing students' capacities for thinking through problems and working cooperatively," students involved in the Copernican Program "performed significantly better than Traditional [sic] students. . ." (Carroll, 1994b, p. 109). It should be noted that Carroll was evaluating his own innovation in this study, and that he might, therefore, have been biased in his conclusions. Other studies appeared to provide more generalizable results.

Additionally, a 1993 study conducted in School District 7, Nelson, British Columbia, reported statistically significant school improvements after adopting a variant on the Copernican model. In that study, failure rates declined in four of the five tenth-grade academic subjects; only in French did the failure rate increase. In eleventh grade, the failure rate declined in eight of nine courses; it increased only in biology. Among twelfth graders, "student performance improved in six of the nine subject areas" (Reid, Hierck, & Veregin, 1994, p. 33). When student achievement was measured using norm-referenced final examinations, however, a 36% decline was found in math, 23% in

biology, 11% in physics, and 6% in communications. "The number of students achieving honor roll status . . . increased by 50 percent [, and] the projected graduation rate climbed from 70 percent to 90 percent" (p. 33).

Not all of the findings in the British Columbia study were positive, however. While grades in two-thirds of the courses tested improved under the Copernican plan, the failure rate actually increased in French among tenth graders, and biology among eleventh graders. Additionally, the failure rates on objective-referenced final examinations increased in history, English, and geography (Reid, et al., 1994).

An additional concern arising from the adoption of intensive scheduling is that retention of knowledge may be adversely affected. This is illustrated by the increased failure rates in certain courses cited in the British Columbia study (Reid, et al., 1994).

Practitioners often base articles and research available on intensive scheduling models upon self-reports and frequently have vested interests in the success of the programs described. In cases where formal evaluations were conducted the results appear mixed. When measured by teacher-designed instruments, acheivement tended to increase. When standardized measures were used, however, student achievement appeared to decrease.

Alternate Day (A/B) Block Scheduling

In some ways, the alternate day (A/B) block schedule is similar to the intensive models. As with the other types of block scheduling, the alternate day (A/B) block schedules focus on the idea of providing fewer classes each day, but for longer periods. In most cases, a student will schedule four classes per day, for approximately 90 minutes per class (Huff, 1995; Ziemke, 1994). Variations include students taking three courses

each day, with each class meeting for approximately 120 minutes, or four periods per day with three meeting for 100–105 minutes, and the other for 45-55 minutes (Canady & Rettig, 1996). The A/B block scheduling plan is also similar to intensive models in that students may earn as many as eight credits in an academic year (Aguilera, 1996).

Although the A/B block is similar to intensive blocks, there is a significant difference. Rather than focusing on a limited number of courses throughout an academic term or semester, the student attending a school using the A/B schedule will be enrolled in each of his/her courses throughout the course of the academic year. In order to accommodate this difference, each course meets every other school day (Aguilera, 1996; Canady & Rettig, 1996; Huff, 1995; Ziemke, 1994). Therefore, in a school using the four-class-period-per-day A/B schedule, a student would take his A day schedule on Monday, Wednesday, and Friday, and his B day schedule on Tuesday and Thursday. The following week, the A day courses would meet on Tuesday and Thursday, and the B day courses on Monday, Wednesday, and Friday. Each class would meet five times in a two-week period. A graphic description of a possible student schedule using the A/B block schedule appears as Figure 2, A Possible Student Schedule for A/B Block Scheduling.

Advantages and Concerns Arising from Adoption of the Alternate Day (A/B) Block Schedule

As discussed above, there are many reasons for adopting a block scheduling model, as well as some concerns regarding its efficacy. Many of the reasons for choosing the A/B schedule are similar to those for adopting intensive models. As was the case with intensive scheduling, the claimed advantages of alternate day (A/B) block

Figure 2. A possible student schedule for A/B block scheduling.

Time	"A Day"	"B Day"
Approx. 90 Minutes	Block I – English	Block I – Social Science
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block II – Elective A	Block II – Elective B
5 – 15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block III – Math	Block III – Science
Approx. 25 Minutes	Lunch	Lunch
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block IV – Elective C	Block IV – Elective D

scheduling fell largely into the same thematic structure: school climate; instruction; and, student outcomes.

School climate. As with intensive scheduling, advocates of A/B scheduling claimed that the model leads to improved school climate (Ziemke, 1994). This was partially borne out in reports from schools that there were fewer discipline problems under the A/B model than prior to adopting the model (Aguilera, 1996). The authors claimed that this reduction may be partially explained by the fact that students have fewer class changes, a time when many of the more serious discipline issues arise (Canady &

Rettig, 1996). Rettig and Canady (1996) speculated that the reported reduction in discipline problems may be attributed to the fact that under the alternate day (A/B) block format, students and teachers who have confrontations are unlikely to see each other every day, allowing for a cooling off period when problems occur.

Instructional issues. Like their colleagues in other block models, teachers and other school leaders who advocate for the A/B block schedule assert that the quality of instruction often improves with the adoption of A/B. Advocates reported that they have more usable instructional time, partially because a smaller percentage of each class period must be devoted to daily record keeping (Canady & Rettig, 1996; Rettig & Canady, 1996). It should be noted that this assertion does not appear to be based upon objective research. This assertion is, in fact, challenged by Wallinger's (1998) study, which found that, at least in the French I classroom, "students who were taught on the daily class schedule had significantly more time available for instruction ($p<.05$) than those taught on either the 4X4 schedule or the alternating day schedule" (p. 163).

Additionally, supporters of alternate day (A/B) block scheduling have asserted that the longer class periods allow teachers the freedom and flexibility to use more variety in their teaching methods (Gerking, 1995; Huff, 1995; Rettig & Canady, 1996). Huff (1995) further argued that the additional time allows teachers more time to deliver and reinforce the key concepts that they want students to retain (Huff, 1995). While these claims appear logical, the authors do not offer evidence to suggest that teachers actually change their strategies to fit the longer class period.

Teachers also expressed concern that, although they may be covering their curricula in greater depth, they often are forced to reduce the amount of material covered

in a class (Gerking, 1995). Dow and George (1998) supported this assertion, suggesting that a teacher must work diligently to determine and follow pacing guidelines, which will allow complete coverage of the curriculum.

Proponents of the alternate day (A/B) block schedule asserted that the additional length of time each day that a teacher is allotted for planning (often as much as twice the time afforded in the traditional schedule) may be used to support teachers in their efforts to strengthen and add variety to their delivery methods (Aguilera, 1996; Canady & Rettig, 1996). Additional planning time may also be used by teachers to reduce their out-of-school workload (Ziemke, 1994). Ziemke further pointed out, however, that this is not always the case, because teachers must prepare for longer classes. None of the authors cited research to support claims that teachers actually used the added planning time to improve instruction.

Student outcomes. One of the primary advantages claimed by advocates of the A/B block schedule is that students increase their level of mastery in a subject when enrolled in a blocked course (Gerking, 1995; Huff, 1995). In an article touting the alternate day (A/B) block model as a possible solution for schools and districts that are experiencing reductions in staffing, Ziemke (1994) argued that this benefit may arise because students in the A/B block typically spend more "time on task;" Ziemke does not, however, support this claim with research indicating that students actually spend more time on task. Others argued that mastery increases because students have fewer classes to prepare for on any given day (Canady & Rettig, 1996; Huff, 1995, Rettig & Canady, 1996; Ziemke, 1994). In the case of laboratory sciences, it may also come from the

opportunity afforded by longer classes to complete more complex laboratory experiments (Gerking, 1995; Huff, 1995). Again, these claims were not supported by research.

Another advantage associated with the A/B block schedule is the opportunity for students to complete eight credits each school year, allowing greater variety in the courses chosen (Huff, 1995; Ziemke, 1994). The additional courses may also be used to schedule what Gerking (1995) described as "enrichment blocks," where students work closely with teachers to design curricula which either expand upon prior coursework or address students' outside interests. Gerking asserted that the use of enrichment blocks are not possible under the traditional schedule. For older students, these enrichment blocks might take the form of community-based learning and/or community service (Dow & George, 1998).

An additional benefit afforded by the flexible schedule is the opportunity for some students to enroll part time in community colleges during their junior and senior years (Aguilera, 1996). They may also be able to begin their postsecondary careers full time, because it is theoretically possible for them to earn enough credits to graduate following only three years of high school (Aguilera, 1996).

Like their counterparts supporting other block scheduling models, advocates for the A/B block schedule also asserted that the model leads to improved student performance, in addition to the opportunities to take additional courses. For example, Aguilera (1996) claimed that students on the A/B block scheduling model improved both their grade point averages and Advanced Placement (A.P.) test scores; he did not, however provide data to support these claims. However, the MERC study (Pisapia & Westfall, 1997) suggested that gains in grade point averages (g.p.a.) are smaller under the

alternate day (A/B) model than the 4X4 block schedule, and that A.P. test scores actually declined in two of the four A/B block schools in their study.

Huff (1995) hypothesized that at least part of the reason for improved grades may arise from students having at least two nights in which to complete homework assignments for a class. This may, he claimed, improve the chances that graded homework will be completed and turned in, and provide greater opportunities to process the material presented in class. On the other hand, the fact that a student has two evenings in which to finish homework gives cause for concern to some. Aguilera (1996) and Ziemke (1994) both suggested that this might encourage teachers to assign more homework than students can realistically handle, causing "homework overloads."

Foreign language and mathematics teachers have questioned some of the claims of improved student outcomes. These groups have expressed concern that classes meeting only every other day decreases instructional continuity (Aguilera, 1996) and that, especially in these disciplines, daily contact with students is desirable for improved retention (Dow & George, 1998; Modern Language Association, 1996). It should be noted, however, that there is no empirical evidence to support these concerns.

Further, these assertions appear to be contradicted by a study that addressed the impact of scheduling practices on student performance in French I. Wallinger (1998) developed a test designed to measure the basic skills taught in beginning level foreign language classes. She concluded "that there was no significant difference ($p<.05$) in the performance of French I students in the skills of speaking, writing, listening, or reading" (p. 163) based upon the scheduling model used at a school.

In the case of standardized tests, one study using 12 schools in Virginia indicated that the A/B block schedule correlated with greater improvement on SAT scores than in schools using the 4X4 block schedule (Pisapia & Westfall, 1997). The authors also reported that Test of Academic Proficiency (TAP) scores were lower under the alternate day (A/B) block scheduling model than the 4X4 semester block scheduling model (after an initially greater, but unsustained improvement under A/B). Additionally, the study indicated that student scores on A. P. tests declined in two of the four schools in the study using the alternative day (A/B) block scheduling model. Because of the small sample size, these results should be viewed with caution.

As was the case with the body of literature discussing intensive scheduling, there is relatively little research-based literature on the efficacy of alternate day (A/B) block scheduling. Most of those who have written about the model assert that it has the potential to improve school climate, force or encourage teachers to increase their instructional repertoire, and increase student achievement and learning. The actual research pays little attention to the first two of these assertions, relying on reports from teachers, and occasionally students, rather than observation to support the assertions. While there have been a few studies that address student achievement under the model, the results were mixed, especially when achievement is measured using standardized testing rather than teacher-made instruments.

4X -Semester Block Scheduling

The literature suggests that, at least in North Carolina, Virginia, and Florida, the 4X4-semester block schedule has become a popular alternative to the traditional six- or seven-class period day. Averett (1994) reported that:

> Implementation of block scheduling is *rapidly growing* in North Carolina. In 1992-93, three high schools, about 1% of all North Carolina public high schools, were implementing a full block schedule. In 1993-94, slightly less than 10% of schools were block scheduled. This year [1994] about 38% [were] block scheduled, and in 1995-96, over 60% of high schools report[ed] that they [would] be implementing block scheduling plans. (p. 1)

An evaluation of a blocked school in southeastern Virginia indicated that:

> in 1992, ninety-six percent of the high school nationwide and ninety-eight percent of Virginia's senior high schools were scheduled using a traditional, six-period day (Kosanovic, 1992, cited in Office of Program Evaluation, 1996). By 1995, however, over forty percent of the high schools nationwide and forty-six percent of the schools in Virginia were using some form of block scheduling. (Hackman, 1995; and O'Neill, 1995, cited in Office of Program Evaluation, 1996)

In Florida, as many as 200 high schools are using some form of block scheduling. Dow and George (1998) reported that "most Florida high schools reported using the 4 X 4 semester schedule" (p. 92), and further asserted that "[f]ew Florida high schools remain untouched by schedule revisions" (p. 92).

Like other alternative scheduling models, the 4X4 block schedule is used to restructure the use of time in the existing school day. In this model, however, students schedule four classes each semester, each of which meets for approximately 90 minutes each day (Aguilera, 1996; Averett, 1994; Canady & Rettig, 1996; Clauson, 1994; Frost,

1993; Gerking, 1995; Schoenstein, 1994; Wilson, 1995). Using this model, a student completes what has traditionally been a year-long curriculum in one semester. During the second semester, the students take four additional courses. Ideally, students in the 4X4 semester block schedule enroll in two core courses and two electives each semester (Pierson, 1994). Typically, teachers will teach three of four class periods, with a 90-minute planning period (Guskey & Kifer, 1995). A graphic description of a typical student's schedule using the 4X4 model appears in Figure 3, A Proposed Schedule for 4X4 Semester Block Scheduling.

A common variant on the pure 4X4 schedule illustrated in Figure 3 allows students in performance music classes, such as band, orchestra, and chorus, to take these classes for the entire school year. When this is the case, the performance class is generally paired with either an academic class or an elective, both of which will meet for 45 minutes per day all year. It should be noted that this variant combines features of the 4X4 schedule with that of the A-B model. This variant is illustrated in Figure 4, A Proposed Schedule for 4X4 Semester Block – Performance Music Student.

Advantages and Concerns Arising from Adoption of 4X4 Semester Block Scheduling

As with the other block scheduling models, proponents of the 4X4 block plan have argued that adoption of the model results in many benefits to students and school staff. The advantages and concerns surrounding the 4X4 semester block will be organized thematically, as they were when discussing intensive scheduling. The themes, school climate, instruction, and student outcomes, remain the same.

Figure 3. A proposed schedule for 4X4 semester block scheduling.

Time	Semester I	Semester II
Approx. 90 Minutes	Block I – English	Block I – Social Science
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block II – Elective A	Block II – Elective B
5 – 15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes (Block) Approx. 25 Minutes (Lunch)	Block III – Math Lunch	Block III – Science Lunch
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block IV – Elective C	Block IV – Elective D

School climate. Perhaps as a by-product of improved student achievement and teaching strategies, proponents of the 4X4 block schedule claim that the model helps to enhance a school's performance by improving the school climate on several interpersonal

Figure 4: A proposed schedule for 4X4 semester block – Performance music student.

Time	Semester I	Semester II
Approx. 45 Minutes	Marching Band/Concert Band/Chorus/Orchestra (year long)	
Approx. 45 Minutes	Social Studies (year long)	
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block II – Elective A	Block II – Elective B
5 – 15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes (Block) Approx. 25 Minutes (Lunch)	Block III – Math Lunch	Block III – Science Lunch
5-15 Minutes	Passing Time	Passing Time
Approx. 90 Minutes	Block IV –Elective C	Block IV – English

levels. Among the arguments made by proponents of the 4X4-semester block scheduling model have included indications that morale improved after leaving the traditional scheduling model (Ever thought . . ., 1994; Pierson, 1994). Guskey and Kifer (1995) conducted a study that confirmed the assertions that the 4X4 semester block scheduling model tends to improve morale at a school. Guskey and Kifer (1995) interviewed teachers at Maryland's Governor Thomas Johnson High School; the teachers believed

that morale increased because of fewer class changes and disruptions. Increases in the numbers of students involved in after school activities are also cited (Pierson, 1994).

At a Florida high school that had recently adopted the 4X4 schedule, students reported that their teachers cared more about them (Dow & George, 1998). Hottenstein and Malatesta (1993) attributed this feeling to what they asserted was "one of the key benefits" of block scheduling, teachers becoming "more intimately involved on a daily basis with helping individual students in the classroom" (p. 28). Additionally, data collected at Lake Brantley, another Florida high school, indicated that "A.P. students were split on their opinion of the block schedule; average students seemed to like it; [and] less successful students seemed to love it" (Dow & George, 1998, p. 102).

Instructional implications. As was the case with intensive scheduling, much of the literature claims that teachers adopted more participatory teaching methods under the 4X4 schedule (Eineder & Bishop, 1997; Ever thought . . ., 1994; Frost, 1993; Wilson, 1995). Others pointed to more specific instructional improvements, including individualization of instructional methods to student needs (Guskey & Kifer, 1995; Pierson, 1994; Schoenstein, 1994; Wilson, 1995), and increased use of field trips (Dow & Green, 1997; Pierson, 1994). Frost (1993) also asserted that teachers were more likely to use methods that encourage critical thinking and problem solving.

These assertions were supported in a 1997 study of alternative scheduling conducted by the Metropolitan Educational Research Consortium (MERC). According to this report:

> Teachers and students in . . . Semester Block school report[ed] that learning [was] not "watered down," but that it [was] "different." There

> [was] more focus on concepts than facts, teachers [went] more in depth on subject matter, and that learning [was] easier only to the extent that students [had] only four classes a day or semester. Students experience[d] more problem solving and information processing skills. Learning [was] more intense in Semester Block schools. (Pisapia & Westfall, 1997, Abstract)

Each of these benefits was attributed to the increase in usable class time pointed out by Rettig and Canady (1996).

At Florida's Newberry High School, Dow and George (1998) reported that "[t]eachers now use more labs, more cross-disciplinary teaching, and more strategies like cooperative learning" (p. 95). One home economics teacher at Newberry said that the 4X4 "schedule works much better in her area, providing time for guest speakers, use of more complex recipes, and extended role-playing exercises" (p. 95).

The literature suggests that improved teaching grew out of block scheduling as a result of both longer blocks of time with the same students, allowing, for instance, for more laboratory time (Gerking, 1995; Pierson, 1994; Snyder, 1997), and more planning time (Guskey & Kifer, 1995). This increased planning time may be used, among other things, to facilitate cooperative teaching (Edwards, 1993; Eineder & Bishop, 1997; Fitzgerald, 1996; Pierson, 1994). In addition, "[b]lock scheduling can offer some advantages . . . include[ing] more laboratory time, less time and effort dealing with problems during hallway passing periods, and a reduction in separate course preparations by teachers" (Fitzgerald, 1996, p. 20; see also Guskey & Kifer, 1995). As was the case

with intensive and alternate day models, no objective research was cited to support these claims.

Dow and George (1998) reported that 69% of the schools they studied reported that, after adoption of the 4X4 semester block schedule, some teachers were revitalized, and 98% of teachers claimed to use "more creative and innovative teaching methods" (p. 104; see also Eineder & Bishop, 1997).

Unfortunately, both Dow and George (1998), and Eineder and Bishop (1997), like most of the other authors who claim that teacher improvement results from the adoption of the 4X4 semester block schedule, relied primarily on self-reports of behaviors, often after teachers attended many in-services that tell them what they ought to be doing during the block. For instance, at Governor Thomas Johnson High School (Frederick County, Maryland) students bemoaned "*the lack of diversity in class activities by some teachers . . .* report[ing] that a few teachers 'simply do the same boring things longer'" (Guskey & Kifer, 1995). It is, therefore, risky to accept blindly that such gains have actually occurred.

Student outcomes. In a 1995 study, Glickman asserted that, to the extent that teaching methods do improve in schools using the 4X4 block, this improvement may be directly related to gains in student achievement. Citing Glickman, Rettig and Canady (1996) wrote that:

> of 12 high schools and 11,000 students reported that schools in which active learning methods were widespread had significantly higher achievement as measured by the National Assessment of Educational Progress. (cited in Rettig & Canady, 1996, p. 41)

While this study may give evidence that 4X4 semester scheduling appears to produce greater student achievement, it does not provide statistical evidence of the effectiveness of the model.

Like proponents of intensive and alternate day scheduling models, supporters of the 4X4 semester block model argued that the plan results in improved student outcomes. Perhaps as a result of the improved climate, some proponents of this scheduling model reported decreases in the numbers of discipline referrals (Aguilera, 1996; Dow & George, 1998; Guskey & Kifer, 1995; Pisapia & Westfall, 1997). For example, Governor Thomas Johnson High School (Frederick, Maryland) reported a 20% reduction in office referrals (30% among freshmen) after switching to the 4X4 block (Guskey & Kifer, 1995).

Canady and Rettig (1996) and Guskey and Kifer (1995) suggested that the decline in discipline problems might be attributed to the fact that there are fewer class changes during the day. In fact, Angola (Indiana) High School "didn't have a single hallway fight the whole first semester [in the 4X4 schedule], a never before recorded statistic" (Snyder, 1997, p. 7). Although this is a positive achievement, it is not clear that the drastic decline in student fights can be attributed to the adoption of 4X4-semester block scheduling.

An additional advantage claimed by proponents of the 4X4 schedule is that student attendance improves. At one school, Hottenstein and Malatesta (1993) reported that attendance increased from 95.8% to 96.7%. They did not indicate whether this increase was statistically significant, however. A study of several schools using block scheduling models conducted by Pisapia and Westfall (1997) found no statistically significant change in attendance.

Among the most often cited features of this model is that the students take only four courses at a time, allowing them to be more focused on their studies and to learn the material in more depth (Aguilera, 1996; Averett, 1994; Canady & Rettig, 1996; Edwards, 1993; Frost, 1993; Guskey & Kifer, 1995; Pierson, 1994; Schoenstein, 1994; Snyder, 1997; Wilson, 1995) or with greater mastery (Edwards, 1993; Fitzgerald, 1996). It should be noted, however, that along with the increases in depth and mastery, the 4X4 semester block schedule might also reduce the degree to which the curriculum is covered. In many cases teachers indicated that they were unable to teach as much of the written curriculum as they could using traditional schedules (Aguilera, 1996; Canady & Rettig, 1996; Dow & George, 1998; Modern Language Association, 1996; Schoenstein, 1995).

However, results of a study conducted at Frederick County, Maryland's, Governor Thomas Johnson High School suggested that the loss of coverage was not inevitable. Based upon data collected from students' scores on standardized tests, Guskey and Kifer (1995) suggested that "coverage appears to be much the same," and added that "because students are enrolled in an additional course each year, total curriculum coverage is likely to be much greater" (p. 8, see also Snyder, 1997).

Other claimed academic gains that may be expected when the 4X4 block is implemented arise from the fact that students take eight courses per year, rather than the six in the traditional schedule. Students may be encouraged or required to retake a course the semester immediately after having failed it the first time (Canady & Rettig, 1996; Clauson, 1994; Dow & George, 1997; Edwards, 1993; Pierson, 1994; Rettig & Canady, 1996). Another advantage to the eight-credit year is that the credits over and above those required for graduation free up the student's time to take more elective courses

(Averett, 1994; Dow & George, 1998; Frost, 1993; Pierson, 1994). At Angola (Indiana) High School, for instance, enrollment in visual arts courses increased by nearly 60% (Snyder, 1997). Similarly, students are able to take more upper-level and A. P. courses earlier in their high school careers (Edwards, 1993; Rettig & Canady, 1996; Schoenstein, 1994; Wilson, 1995). This has proven to be the case at Flagler/Palm Coast High School (Bunnel, Florida), where more students take higher level math classes, and in Orlando's University High School, where "numbers of students in advance [foreign language] sections [has risen]" (Dow & George, 1998, p. 99). The study did not address whether these increases were statistically significant.

Proponents further claimed that a related benefit is the opportunity for students to complete enough credits to enroll in college courses while still in high school (Aguilera, 1996; Dow & George, 1998) or to graduate in as little as three years (Aguilera, 1996; Schoenstein, 1994). Additionally, Edwards (1993) reported an increase in graduation rates among students in blocked schools. He did not indicate whether the increase was statistically significant.

In some instances, the literature supports many of these claims, at least on a limited basis. For example, Aguilera (1996) reported that A.P. test scores increased when Williams High School (Williams, Arizona) adopted the 4X4 block schedule. At University High School (Orlando, Florida), A.P. "scores [were] reportedly higher than ever; 73 percent of the students taking the exams in 1995 scored a 3 or better" (Dow & George, 1998, p. 99). However, students' scores on the tests were not reported for the period immediately prior to the adoption of the block model, so it is impossible to determine how much of an increase actually took place and whether the increase was

significant. Aguilera (1996) further reported that "failure rates dropped during the first semester of the 1993-94 school year [the last year in the traditional schedule] from 29 to 12 percent during the 1994-95 school year" (p. 3). These findings were supported in studies by Guskey and Kifer (1995) and Snyder (1997).

Claims of improved performance on A.P. tests under the 4X4 semester block plan were challenged, however, by the Metropolitan Research Consortium (MERC) study, which was completed in 1997 (Pisapia & Westfall, 1997). This study found that a smaller percentage of students took A.P. tests, and that fewer of them achieved scores of 3 or better (Pisapia & Westfall, 1997).

Eineder and Bishop (1997) pointed out that, after adopting the 4X4 schedule at Philo High School (Ohio), there was a 92% increase in ninth graders on the honor role, and a 24% increase in the number of A's and B's earned by eleventh and twelfth graders. Higher grades were also noted at Flagler/Palm Coast High School (Bunnel, Florida), where 50% of students were on the honor roll (as opposed to only 27% when the school was on a seven-class period day), and the grade point averages of all students increased. The gains appeared to be consistent across Florida's high schools using the 4X4 block, where 65% of the schools using the model reported that their honor rolls have grown, and 50% indicated that their students' grade point averages have improved (Dow & George, 1998). Similar increases were reported by Pisapia and Westfall (1997) and Snyder (1997). It should be noted that the rates of students appearing on honor rolls reflect only teacher-assigned measures of academic achievement, rather than more reliable standardized tests.

When one measures student gains using norm-referenced tests, however, the results are less clear. In an evaluation of the 4X4 scheduling model in North Carolina, Averett (1994) asserted that "preliminary indications are that across all schools block scheduling has had little effect on end-of-course test scores to date" (p. 4). Furthermore, Parkland High School (Winston-Salem, North Carolina) reported that, in their first semester on the 4X4, their "overall North Carolina End-of-Course Test scores were lower than the previous year," but further indicated that they had ". . . improved in June from [their] January results . . ." (p. 68).

Similarly, Eineder and Bishop cited two Canadian studies, which found that block scheduling had a negative impact on math achievement (Raphael et al., 1986, cited in Eineder & Bishop, 1997) and science (Bateson, 1990, in Eineder & Bishop, 1997). Eineder and Bishop warned that the results of the two Canadian studies might be suspect because of a long time gap between the end of the course and the test. While it is unknown whether these results were affected by the time gap, they do suggest that retention may be adversely effected by the adoption of the 4X4 model. This is consistent with the claims of Canady and Rettig (1996). Kramer (1997) suggested that the retention problem is especially serious in mathematics courses, and pointed out the necessity to carefully schedule students so that they take their math courses in successive semesters whenever possible.

In smaller studies, reports of the impact of the 4X4 block schedule on student achievement on standardized tests are also mixed. An evaluative study conducted at Governor Thomas Johnson High School (Frederick, Maryland) indicated that "fluctuations in the pass rate in all subject areas [on the Maryland Functional Tests]

[were] small and insignificant" (Guskey & Kifer, 1995, p. 7) when compared to the school's scores on the tests before switching to the block. Similarly, student scores on the Frederick County Summative Tests in math, social studies, and science were also found to be stable (Guskey & Kifer, 1995). It is interesting to note that Guskey and Kifer found that, while the grades on these tests were stable for the school population as a whole, the grades on the Maryland Functional Tests in mathematics and citizenship were significantly higher among African-American students (20.5% increase in mathematics and 21/3% increase in citizenship scores).

Several studies indicated that most standardized test scores either improved or remained constant. Small but statistically insignificant gains were also noted on Scholastic Aptitude Test (SAT) scores (Snyder, 1997). Significant improvements were reported on the American College Testing Assessments (ACT), and the Indiana State Test of Educational Proficiency (ISTEP+) (Snyder, 1997). The ACT gains were consistent with those cited by Wilson (1995), where "a Program from Omak, Wash., showed increased ACT scores and grade point averages for three years" (Aquilera, 1996, p. 63) (see also, Pisapia & Westfall, 1997).

Comparative Analysis

In comparing the relative benefits and concerns surrounding block scheduling, it is logical to use the thematic structure suggested by the literature. I will, therefore, compare them based upon their effects upon: (a) the school climate; (b) instruction; and, (c) student outcomes. In cases where similar claims have been made for two or more of the models, more weight will be given to those that have been borne out by research. In

all comparisons, the traditional six- or seven-class period day is taken as an informal baseline.

Effects upon school climate. In comparing the apparent effects of the various models of block scheduling on school climate, the differences between the models is not clear. In each model, both students and teachers report greater satisfaction in the block model than under the traditional schedule (Alam & Seick, 1994; Carroll, 1994b; Ever thought . . ., 1994; Guskey & Kifer, 1995; Pierson, 1994; Ryan, 1991; Snyder, 1997). Because the surveys used different instruments, it is difficult to compare the percentages of students and teachers who were satisfied. Similarly, some reports in the literature noted that all three models fostered deeper, more meaningful relationships between students and their teachers and peers (Andersen, 1982; Dow & George, 1998).

An additional benefit that was noted with the 4X4 model is increased student involvement in extracurricular activities (Pierson, 1994). Neither the literature on intensive scheduling nor alternate day (A/B) block models noted such advantages. This discrepancy may be a result of the fact that there appears to be much more literature on the 4X4 semester block schedule than on either of the other two models.

An advantage of the alternate day format of the A/B block was also noted. Rettig and Canady (1996) pointed out that, when there are problems or disagreements between students and their peers or teachers, the fact that classes do not meet every day allows for a "cooling off period" which may keep these problems from becoming confrontations. Although this potential benefit is not addressed by any studies, and may, therefore, not make a significant difference in reducing discipline problems, it is not even a potential

benefit of either the intensive model or the 4X4 model, because classes meet each day under these models.

There is no indication in the literature that any of the block scheduling models present any adverse effects on school climate.

Figure 5, Relative Effects on School Climate: A Summary of Identified Literature, presents a graphic Summary of this analysis. If a decision on the type of block scheduling model to be used is to be based solely upon its effects on school climate, it is clear that the advantages offered by the 4X4 and A/B schedules are similar to those found with Intensive scheduling. Both the 4X4 and A/B schedules offer additional advantages not claimed by the literature on the intensive model.

Figure 5. Relative effects on school climate: A summary of identified literature.

	Intensive Model	4X4 Model	A/B Model
Advantages	• Deeper relationships with teachers and peers • Reported satisfaction with model (students and teachers)	• Deeper relationships with teachers and peers • Reported satisfaction with model (students and teachers) • Increased involvement in extracurricular activities	• Deeper relationships with teachers and peers • Reported satisfaction with model (students and teachers) • "Cooling off period" to avert confrontations
Disadvantages	• none	• none	• none

Because the 4X4 semester block and alternate day (A/B) block scheduling models do not share the additional advantages, and they are so different in kind, attempting to judge which of the models offers the greater advantages is problematic. Therefore, in a

school in which there are few problems with confrontations between students or students and staff, or where increasing involvement in student activities is highly valued, the 4X4 schedule appears to be more desirable. If, however, the school has had a history of confrontations, or if the student activities program is well established and attended, then the A/B model would be the better choice.

Effects upon instruction. Perhaps because each of the block scheduling models grew out of the same tradition and share the basic feature of longer class periods and fewer classes per day, many of the potential advantages offered are very similar. In the case of each of the models, more usable instructional time is available to teachers, based primarily upon the fact that a smaller percentage of time must be spent each class period on such book-keeping issues as taking attendance (Canady & Rettig, 1996; Rettig & Canady, 1996). Additionally, the literature on each of the models suggests that teachers tend to expand their teaching repertoires to involve strategies requiring more student participation, more cooperative learning, and more techniques designed to promote mastery learning (Andersen, 1982; Eineder & Bishop, 1997; Ever thought . . ., 1994; Frost, 1993; Gerking, 1995; Huff, 1995; Rettig & Canady, 1996; Wilson, 1995). While the literature on each of the models indicates that the additional time available to teachers allows them the opportunity to improve and increase their teaching strategies, empirical evidence only exists to suggest that this is actually the case in the 4X4 block scheduling literature (Dow & George, 1998; Eineder & Bishop, 1997).

An additional benefit of the potential to improve instruction is the fact that teachers have more time available during the work day that they can devote to planning instruction or pursuing professional development activities (Aguilera, 1996; Andersen,

1982; Canady & Rettig, 1996; Carroll, 1990; Edwards, 1993; Eineder & Bishop, 1997; Fitzgerald, 1996; Guskey & Kifer, 1995; Pierson, 1994).

It should be noted that each of the advantages enumerated above could also become the greatest liability of block scheduling models. Ineffective instructors who do not take advantage of the opportunity to improve and expand their techniques can have a greater adverse impact on student learning when they have them in class for longer periods of time. As a student at Frederick County, Maryland's, Governor Thomas Johnson High School observed "a few teachers 'simply do the same boring things longer'" (Guskey & Kifer, 1995).

An additional advantage of the intensive scheduling model that is not shared by the other models is the ability to take field trips without having to pull students from other classes (Andersen, 1982).

To the extent that the potential advantages for instruction grow out of a reduction in the number of students and preparations for which a teacher is responsible, the intensive and 4X4 semester block scheduling models would appear superior to the alternate day (A/B) model. In the intensive model, teachers might be expected to have between 25 and 60 students in their charge, and not more than two preparations per academic term. By comparison, instructors working at schools using the 4X4 semester block scheduling model might have as many as 90 students and two or three preparations per semester. At first glimpse it might appear that teachers in the alternate day (A/B) model would have similar numbers of students and preparations as their colleagues in the 4X4 semester block scheduling model. This is true on a daily basis, but when one considers the entire schedule for the term, it is apparent that instructors in A/B scheduling

models actually have as many as 180 students and three or four (or more) preparations. These increased numbers might logically be expected to partially negate the benefits that arise with increased planning time and having fewer classes per day. This information is summarized in Figure 6, Relative Effects upon Instruction: A Summary of Identified Literature.

Figure 6. Relative effects upon instruction: A summary of identified literature.

	Intensive Model	4X4 Model	A/B Model
Use of Additional Techniques	Asserted	Asserted; Verified in some studies	Asserted
Available Planning Time	Asserted Increases	Asserted Increases	Asserted Increases
Number of Students/term	25-60	75-90	150-180
Number of Class Preparations/ term	1-2	1-3	1-6
Field Trips	Do not impact other classes	Impact three additional classes	Impact three additional classes

In comparing the effects of the three block scheduling models on quality of instruction, it appears that both intensive scheduling and the 4X4 block are superior to the A/B block. This is primarily because many of the assumed positive impacts attributed to the block model arise from the reduction in the number of classes and students. Because the teacher may expect both more students and more preparations, and in the absence of empirical data to the contrary, it is probably safe to assume that the potential benefits will be somewhat tempered. It is important to remember here that, although improved instruction is assumed by proponents of each of the scheduling models, there have been no studies which involve classroom observations, nor have there been any causal-comparative studies conducted.

When distinguishing between the relative advantages of intensive and 4X4 semester block scheduling, the same reasoning would appear to be on less sure ground. In the absence of empirical data, one cannot properly assume that having approximately 60%–80% fewer students than in traditional models is more beneficial than teaching 40% fewer students. Even if one accepts the assertion that having fewer students per term is better, no evidence exists to determine how many fewer students is optimal for improving teaching performance.

The principal differences between findings on intensive scheduling and the 4X4 semester block, then, come down to the greater ease with which field trips may be taken without disrupting the rest of the instructional day, and the fact that there are empirical data supporting the perception that teaching strategies do become more diverse under the 4X4 semester block plan. Because of the cost and periodic nature of field trips, and the fact that improved instructional practices may be displayed on a daily basis, the 4X4 block scheduling model appears to be slightly better than intensive scheduling if forced to make a decision based solely upon the effects of block scheduling on instructional practices.

Effects upon student outcomes. While the effects of the various models of block scheduling on the school budget, climate, and instructional strategies are undeniably important, the most important consideration when making any change to an educational program must be its impact on student achievement. Student achievement, generally, may be put into two categories, nonacademic achievement and academic gains. In both 4X4 and A/B block scheduling models, there has been an observable decline in student discipline referrals (Aguilera, 1996; Guskey & Kifer, 1995; Pisapia & Westfall, 1997); no

such claim was found in the literature about intensive scheduling, although a reduction in the number of suspensions was noted (Carroll, 1994b). An additional nonacademic claim made by some advocates of the block scheduling models addresses attendance and dropout statistics. While advocates of all three scheduling models claim improvements in these areas, the statistical data indicate a significant reduction in the dropout rate and small improvements in attendance under intensive models (Carroll, 1994b). One statistical measure of these factors for the 4X4 and A/B models found no significant impact on either factor (Pisapia & Westfall, 1997). Another found a statistically significant increase in student attendance (Snyder, 1997).

There have been many claims lauding increases in academic achievement under each of the block scheduling model. One of the most common is that student grades improve when the model is adopted (Alam & Seick, 1994; Andersen, 1982; Dow & George, 1998; Eineder & Bishop, 1997; Huff, 1995; Reid et al., 1994; Ryan, 1991; Snyder, 1997). Although no comparison has been made concerning the amount of increase in grades in intensive scheduling with those of either 4X4 block or A/B schedule, there is evidence that grade point averages improve more among those on the 4X4 model than on the A/B. Unfortunately, however, while these gains are verifiable, taken by themselves, they give little useful information for comparing actual student learning because they may be measuring different outcomes, using different methods.

Similarly, the literature for each of the models of block scheduling asserts that one can expect to see an increase in the levels of depth and mastery that accompany student learning (Aguilera, 1996; Averett, 1994; Canady & Rettig, 1996; Carroll, 1990, 1994b; Edwards, 1993; Fitzgerald, 1996; Frost, 1993; Gerking, 1995; Guskey & Kifer, 1995;

Huff, 1995; Pierson, 1994; Schoenstein, 1994; Snyder, 1996; Wilson, 1995). None of the studies, however, addressed how (or whether) mastery was verified; therefore, the reader must remain skeptical.

In attempting to make meaningful comparisons of student achievement, perhaps better measures than those discussed above would be results on standardized tests. In this case, however, the comparisons must be limited, because few studies have been published that measure academic achievement in block scheduling research using standardized tests. Among studies measuring student achievement using objectives-referenced end-of-course tests, results appear to be largely inconclusive. For example, one study found no significant differences between students on Intensive scheduling and those enrolled in traditionally scheduled classes (Carroll, 1994b). Another found that failure rates on objectives-referenced end of course tests generally improved, but that scores actually declined (and failure rates increased) in math, biology, physics, and communications (Reid et al., 1994).

Studies attempting to measure the impact of the 4X4 block using standardized tests also yield mixed results. In a North Carolina study, Averett (1994) found that, in blocked schools across the state, block models appeared to have little impact on scores. A study in Maryland also found that there was not a significant difference in test scores at the school after adoption of the 4X4 plan. It should be noted at this point, however, that there were statistically significant increases in scores among African American students in the study (Guskey & Kifer, 1997). Eineder and Bishop (1997) cited two Canadian studies, which indicated that block scheduling had a negative impact on standardized test

results. This finding must be considered in light of the fact that there was a significant time lag between finishing the courses and taking the tests.

When achievement is measured in terms of nationally normed tests, such as the SAT, ACT, and TAP, results are similarly mixed. While no data for these tests for schools using intensive scheduling models were located, there are grounds for comparison of schools using the 4X4 and A/B blocks. According to several studies, small, but insignificant, gains in SAT scores may be expected (Snyder, 1997; Wilson, 1995), with scores slightly higher for students on the A/B schedule than for those on the 4X4 (Pisapia & Westfall, 1997). Snyder (1997) also found significant increases on ACT test scores among students enrolled under the 4X4 model. Similarly, TAP test scores were higher for students enrolled under the 4X4 block than for those in schools using the A/B (Pisapia & Westfall, 1997).

The impact of block scheduling on A.P. tests also appears to be mixed and inconclusive. While no research was located that addressed the impact of intensive scheduling or A/B block on A.P. test scores, several studies addressed the impact of either 4X4 models. While evaluation studies of four schools using 4X4 block scheduling claimed significant increases in both the numbers of students taking A.P. tests and their pass rates (defined as scores of "3" or above) (Aguilera, 1996; Dow & George, 1998; Guskey & Kifer, 1995; Snyder, 1997). However, a study of nine schools on various block scheduling models found that fewer students took the A.P. tests, and that fewer of them achieved passing scores (Pisapia & Westfall, 1997).

Finally, concerns over declines in student retention have been raised in the case of intensive and 4X4 scheduling (Canady & Rettig, 1996; Kramer, 1997; Reid et al., 1994; Rettig & Canady, 1996)

These comparisons are illustrated graphically in Figure 7, Effects Upon Student Achievement: A Summary of Identified Literature.

Figure 7. Effects upon student achievement: A summary of identified literature.

Measure	Intensive Model	4X4 Model	A/B Model
Discipline	Fewer suspensions	Fewer referrals	Fewer referrals
Drop-out rates	Decline	No difference	No difference
Attendance	Slight improvement	No difference or increased	No difference
Student grades	Increase	Increase (greater than A/B)	Increase (not as great as 4X4)
Depth	Increase	Increase	Increase
Mastery	Increase	Increase	Increase
Standardized end of course tests	Mixed (no difference or depended on subject)	Mixed (no difference or slight negative impact); Increase Among African Americans	No data
SAT scores	No data	Small gains (lower than in A/B)	Small gains (greater than in 4X4)
ACT scores	No data	Significant increases	No data
TAP scores	No data	Increases	Slight initial increases
A.P. Tests	No data	Mixed (4 studies, increases; 1 comprehensive study, decreases)	No data
Retention	Declines	May decline	No claimed impacts

When choosing between scheduling options based upon student achievement, it is clear that the literature provides little reliable data on which to base a decision. With this in mind, the model that appears to have the greatest potential for improving student performance appears, based on available data, to be the 4X4 semester block schedule.

This decision is based primarily upon the fact that studies show the potential for this schedule to positively impact student grades, depth and mastery of learning, end-of-course tests (at least among African-Americans), and SAT, ACT, TAP, and A.P. tests. Additionally, there are no strong contraindications arguing against its adoption.

Summary

While much of the literature on alternative scheduling is very optimistic with regard to the potential benefits for student achievement, few articles have been published that report reliable and objective evidence that these benefits are actually being achieved. Most of the studies identified in the literature focus upon teacher and student reports of satisfaction with the various models, and student achievement as measured by teachers. While this information is valuable, it does not inform the practitioner of the potential of the scheduling models to impact student achievement on objective measures, such as norm-referenced assessments given at or near the end of a course. A need exists, therefore, to expand the research base that addresses actual student achievement differences using various scheduling models. This study proposes to add to the research base by addressing differences in student achievement on the Virginia Standards of Learning high school level end-of-course assessments.

CHAPTER 3

METHODOLOGY

The major purposes of this study were to: (a) assess the impact of block scheduling models on high school student achievement; (b) to explore whether the urbanicity of the community served by a high school is related to its success with block scheduling models; and (c) to determine whether there is a relationship between the number of years that a school has used block scheduling models and student performance on the Virginia Standards of Learning end-of-course assessments. For the purposes of this study, student academic achievement was measured using pass rates and student scores on the Virginia Standards of Learning end-of-course assessments.

Research Questions

The study was designed to address the following research questions, which attempted to discover the relationship between student academic achievement and the block scheduling methods commonly used in Virginia's public high schools:

1. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method, the traditional six-class period day, and/or the traditional seven-period day scheduling models?
2. Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using alternate day (A/B) block

scheduling, the traditional six-class period day, and/or the traditional seven-period day?

3. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?
4. Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?

Population and Sample

All Virginia public high schools using the 4X4 semester block schedules, alternate day (A/B) schedule, and those using the traditional six- or seven-class period schedules, were identified using public records available through the Virginia Department of Education. Each of the schools using one of the target scheduling methods was included, thus eliminating several of the problems inherent in attempting to choose a representative sampling of schools.

Procedures

The Virginia Department of Education provided the researcher with raw data indicating the scores and pass rates for each of the Commonwealth's public high schools on the Virginia Standards of Learning end-of-course assessments administered during the 1998-1999 school year. These data were provided to the researcher in electronic form, using a Microsoft Excel format. Data were extracted from this Virginia Department of Education data base to determine the scores for each school on each of the high school Standards of Learning end-of-course assessments, with the exception of the English 11

tests, as well as the type of schedule being used and length of time that the school has used its current scheduling method. This database was also be used to determine the urbanicity of the school. All data used represented school means and pass rates without addressing the scores of individual students.

Research Design

The design of this study was quantitative, using a causal-comparative design to compare the results of schools on the Virginia end-of-course Standards of Learning tests, based upon the scheduling model used and type of community served. Data were gathered from testing sessions in the fall and spring semesters of the 1998-1999 school year, using Virginia Department of Education databases.

Instruments

The Virginia Standards of Learning end-of-course assessments, which were first administered in the spring semester 1998, and which assessed student achievement in "English: reading/literature and research, English: writing, mathematics, United States history, world history/geography, and science . . . are designed to test the extent to which students have learned the content and skills specified in the Virginia SOL" (Virginia Department of Education, 1999, p. 4). Each of these multiple-choice tests is administered during the school day.

Each of these tests were used in this study with the exception of the English tests, which were eliminated because they are intended to measure knowledge and skills accumulated over several years, rather than in a single course. Mathematics tests included: Algebra I, Algebra II, and Geometry. Science tests were given in Earth Science, Biology, and Chemistry. Social Studies tests were administered in U. S.

History, World History to 1000 A.D./World Geography (World History A), and World History from 1000 A.D. to the Present/World Geography (World History B).

These tests are all criterion-referenced, with minimum pass scores set by the Virginia Department of Education. The tests were administered on the schedule set by the Virginia Department of Education.

Content Validity

The Virginia Department of Education, in conjunction with outside experts, has established the validity and reliability of each of these tests. On each of the assessment instruments, content validity was established by a Content Review Committee, which based its judgments on four criteria:

- Does the question measure the SOL it was designed to measure?
- Does the question appropriately measure content or skills that students in Virginia should be expected to learn . . . near the end of the course?
- Is the difficulty of the question appropriate?
- Is the question free from content that stereotypes, offends, or unfairly penalizes students on the basis of personal characteristics such as gender, ethnicity, religion, or socioeconomic status? (Virginia Department of Education, 1999).

After questions were deemed valid by the Content Review Committees, they were field-tested.

Following field-testing, statistics were generated using traditional item statistics, Rasch item statistics, and Differential Item Functioning (DIF). The Content Review Committees used these statistics to assess each item following field testing. Any item that was deemed invalid was eliminated.

Finally, a Bias Review Committee subjected each item accepted for use by the Content Review Committee to a separate "bias review." Again, any question deemed biased was eliminated.

Statistical Measures of Validity

According to Phillips (Virginia Department of Education, 1999), "[a]nother type of validity evidence that may provide useful descriptive information about a test is correlations with other measures. The other measures can be instruments that measure similar content or different content than the test of interest . . ." (p. 8). The Virginia Standards of Learning end-of-course assessments for high school mathematics were statistically correlated with the Stanford 9 and Virginia Literacy Passport tests (LPT). This analysis indicated that, "[w]hile overall performance on the SOL tests is dramatically lower than on the *Stanford 9* and the *LPT*, the relative standing among schools is very similar" (p. 8).

Phillips reported that:

> The school level rank order correlations for the Virginia and Stanford 9 subtests . . . are in the expected range . . . The SOL mathematics tests appear to rank order schools more similarly to Stanford 9 mathematics problem solving than mathematics procedures." (Virginia Department of Education, 1999, p. 9)

McMillan added that:

> Evidence for validity based on relations to other measures has been provided and is more than adequate for this type of test. The moderate magnitude of the correlations between the SOL tests and established

> measures of similar knowledge and skills is what would be expected since the measures that are correlated do not match each other completely . . . Consequently, the correlations (sic) obtained in the range between .53 and .85 are consistent with expectations." (Virginia Department of Education, 1999, p. 9)

Reliability

The Kuder-Richardson Formula #20 (KR-20) was used to determined the reliability of test items on the Virginia Standards of Learning end-of-course assessments. Phillips asserted that "[t]he general rule of thumb for high-stakes decisions about individuals is a minimum of .85" (Virginia Department of Education, 1999, p. 11). Each of the tests used in this study meets or exceeds this bench-mark, as illustrated in the Table 1, Reliability Data for Virginia Standards of Learning End-of-Course Assessments.

Table 1

Reliability Data for Virginia Standards of Learning End-of-Course Assessments

Standards of Learning Assessment	KR-20
Algebra I	0.88
Geometry	0.85
Algebra II	0.86
U.S. History	0.90
World History to 1000 + World Geography	0.91
World History from 1000 + World Geography	0.91
Biology	0.88
Earth Science	0.87
Chemistry	0.88

(adapted from Virginia Department of Education, 1999).

Test Content

The specific content covered by each of these tests is documented in a series of blueprint booklets published by the Virginia State Department of Education. These booklets may be obtained from that source.

Passing Scores

The minimum pass scores for each test is included in the Appendix, Virginia Standards of Learning Assessments: Passing Scores Established by the Board of Education. A modified Angoff technique was used to establish these scores.

Data Analysis

Question 1

The difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method, and/or the traditional six- or seven-class period day scheduling models were analyzed using a 3X3 analysis of variance. Where differences were noted, the Tukey-b followup test was used.

Question 2

The difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method, and the traditional six- or seven-class period day scheduling models was analyzed using a 3X3 analysis of variance. Where differences were noted, the Tukey-b followup test was used.

Question 3

The interaction between the scheduling method used, pass rates on the Virginia Standards of Learning end-of-course assessments, and urbanicity was analyzed using a

3X3 analysis of variance. Where differences were noted, the Tukey-b followup test was used.

Question 4

The interaction between the scheduling method used, student scores on the Virginia Standards of Learning end-of-course assessments, and urbanicity was analyzed using a 3X3 analysis of variance. Where differences were noted, the Tukey-b followup test was used.

Acceptable Error

On all statistical analyses, significance was reported at an alpha level of 0.05 ($\alpha < .05$). In all cases, the actual alpha level was also reported.

It should be noted that this study was intended to determine differences between and the relationships among the effects of the variables studied on student achievement on the Virginia Standards of Learning assessments, but was not intended to establish causality because the interventions were implemented prior to the commission of the study. Additionally, the fact that there was no way to tightly control the specifics of how each schedule is implemented in each school, or the specific instructional methods used in each school, mitigates against establishing causal relationships.

Ethical Considerations

Although all of the variables addressed in this study are available in the public domain, measures were taken to protect the anonymity of students, schools, and school divisions. The study was designed so that the scores of individual students were not necessary, only averages and ranges from the schools. Additionally, the schools were assigned numbers, and were referred to in the study only using descriptive data limited to

geographic region, type of population served, and type of scheduling model used. Only the researcher maintained access to the codes. Additionally, the Human Subjects Review Board for the School of Education at the College of William and Mary in Virginia approved this study.

CHAPTER 4

ANALYSIS OF RESULTS

This chapter contains a description of the study and data analysis procedures, as well as an analysis of the data collected. The study was undertaken to explore the possible effects of scheduling models used in Virginia's public high schools on student testing as measured by pass rates and scores on the high school level end-of-course Standards of Learning tests. The schools included in the study were those using 4X4 block scheduling, alternative day (A/B) scheduling, and those using the traditional six- or seven-class period day scheduling models. The study also addressed the possible interaction effects of urbanicity.

The research questions addressed in this study follow:

1. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) Block scheduling method, the traditional six-class period day, and/or the traditional seven-period day scheduling models?
2. Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using alternate day (A/B) block scheduling, the traditional six-class period day, and/or the traditional seven-period day?

3. Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?
4. Is there a difference in the scores of student taking Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?

In each case, the answers to these questions were examined using statistical analysis of data provided by the Virginia State Department of Education.

Two additional questions, both dealing with possible interactions of the number of years that a school had been using a given scheduling model and the scheduling model itself, were eliminated from the study. These questions were dropped because records could not be located indicating how long schools using traditional scheduling models had been using them.

Methodology

Initially, the researcher determined the type of scheduling model used by each of the public high schools in the Commonwealth of Virginia using information compiled by Dr. Michael Rettig in cooperation with the Virginia State Department of Education and reported on an Internet web site (Rettig, 1999). The pass rates on the end-of-course Standards of Learning tests for each school represented in the study were obtained from a publication provided by the Virginia State Department of Education (1999). The mean scaled scores for each of the schools were provided to the researcher in Excel format via e-mail from the Virginia State Department of Education.

The researcher then transposed the information about each school's scheduling model, urbanicity, pass rates, and mean scores for the target measures in an SPSS data file to be used for statistical analysis.

Description of Sample

The sample included each of the 289 public high schools in the Commonwealth of Virginia that were using either the A/B block schedule, 4X4 block schedule, traditional six- or seven-class period day during the 1998-1999 academic year. Twenty-eight schools were eliminated from the study because they are alternative programs, and five others were eliminated because they do not use one of the targeted scheduling models.

The most important division for this study is the scheduling model used by each school in the sample. This is represented in Table 2, Sample Sizes by Scheduling Model.

Table 2

Sample Sizes by Scheduling Model

Scheduling Model	Number of Schools in Sample
A/B Alternative Day Block	104
4X4 Block	91
Traditional Class Period Day	94
Total Schools in Sample	289

When crosstabulated with the urbanicity of the school, these samples were further broken down as illustrated in Table 3, Scheduling Model Used * School Community Crosstabulation. This is displayed graphically in Figure 8, Description of Sample.

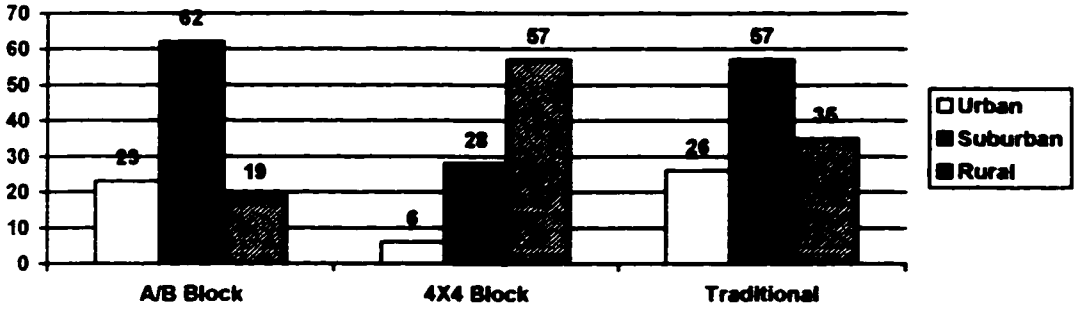
Table 3

Scheduling Model Used * School Community Crosstabulation

		School Community			
		Urban	Suburban	Rural	Total
Scheduling Model Used	A/B Block	23	62	19	104
	4X4 Block	6	28	57	91
	Traditional day	26	33	35	94
	Total	55	123	111	289

Note: An asterisk (*) denotes an interaction between variables.

Figure 8. Description of sample.



Note to the Reader

When there is a significant interaction between two or more variables in a factorial analysis, main effects for either of the interacting factors "may be artifactual and may not present meaningful results about the effect of that independent variable" (Kiess, 1996, p. 318). Conventional wisdom, therefore, asserts that, when reporting the results of a multifactoral analysis of variance, significant main effects should only be reported in the absence of a significant interaction between variables. Because of the nature of the research questions in this study, the researcher has elected to report the results of statistically significant main effects whether or not an interaction exists.

Percentage of Students Passing

The percent of students passing the end-of-course SOL tests in 1998-1999 was obtained for each high school in the Commonwealth of Virginia. These were reported in

a document obtained from the Virginia State Department of Education (Department of Education, Division of Assessment and Reporting, 1999). The pass rates on each of the tests varied widely, both from school to school and test to test.

End-of-Course Algebra I Test

All but five of the 289 schools included in this study administered the end-of-course Algebra I test. Taking the sample as a whole, pass rates ranged from zero to 100% passing (M = 39.8, SD = 20.7). The highest pass rates were reported for schools using the traditional day (M=42.8, SD=21.2). Schools using the A/B alternating day block schedule had a mean pass rate of 38.6 (SD=20.9), and those using the 4X4 semester block schedule produced the lowest mean percentage of students passing (M=37.9, SD=20.0). Table 4, Descriptive Statistics for Pass Rates on End-of-Course Algebra I SOL Test, reports the mean pass rates for each of the three scheduling models, broken down by urbanicity.

Table 4

Descriptive Statistics for Pass Rates on End-of-Course Algebra I SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Algebra I Pass Rate	A/B Alt. Day	■ Urban	32.3	22.0	23
		■ Suburban	42.1	20.9	59
		■ Rural	35.4	17.9	19
		Total	38.6	20.9	101
	4X4 Block	■ Urban	09.7	7.9	5
		■ Suburban	38.4	15.5	28
		■ Rural	40.3	20.9	56
		Total	37.9	20.0	89
	Traditional	■ Urban	43.6	19.2	26
		■ Suburban	44.9	22.0	33
		■ Rural	40.1	22.0	35
		Total	42.8	21.2	94
	Total	■ Urban	35.6	21.9	54
		■ Suburban	42.0	20.1	120
		■ Rural	39.4	20.7	110
		Total	39.8	20.7	284

The researcher analyzed the percentage of students passing the end-of-course Algebra I SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the pass rates for the main effects of both school community and scheduling model. Additionally, the results suggested that there was a significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 5, Algebra I Pass Rate by Scheduling Model Used, School Community.

Table 5

Algebra I Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	4940.0	2	2470.0	5.964	.003
School Community	4358.9	2	2179.5	5.262	.006
Scheduling Model*School Community	4545.8	4	1136.5	2.744	.029
Error	113891.4	275	414.2		

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interaction effect. The pass rates for schools in urban communities using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for either suburban or rural schools using the 4X4 block schedule, for schools in suburban communities using the alternate day (A/B) block schedule, and for schools using traditional schedules, regardless of community. This is displayed in Table 6, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra I Pass Rates. The interaction is displayed graphically in Figure 9, Interaction of Scheduling Model and School Community on Algebra I Pass Rates.

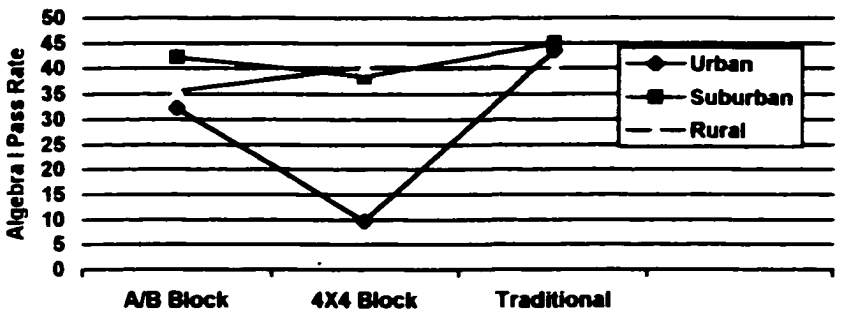
Table 6

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra I Pass Rates

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	9.7	
A/B * Urban	23	32.3	32.3
A/B * Rural	19	35.4	35.4
4X4 * Suburban	28		38.4
Traditional * Rural	35		40.1
4X4 * Rural	56		40.3
A/B * Suburban	59		42.1
Traditional * Urban	26		43.6
Traditional * Suburban	33		44.9

Note: An asterisk (*) denotes an interaction between variables.

Figure 9. Interaction of scheduling model and school community on Algebra I pass rates.



End-of-Course Geometry Test

All but three of the 289 schools in the study administered the end-of-course Geometry test. Taking the sample as a whole, the percentage of students passing this test ranged from zero to 100 % (M=55.3, SD=19.7). The highest pass rates were reported for schools using the traditional scheduling model (M=59.8, SD=17.2), followed by those using the A/B alternate day block schedule, which produced pass rates only slightly lower (M=58.9, SD=18.9). Schools operating under the 4X4 semester block schedule had a somewhat lower mean pass rate (M=46.1, SD=20.3). Table 7, Descriptive

Statistics for Pass Rates on End-of-Course Geometry SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 7

Descriptive Statistics for Pass Rates on End-of-Course Geometry SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Geometry Pass Rate	A/B Alt. Day	■ Urban	50.3	21.2	23
		■ Suburban	64.9	15.8	62
		■ Rural	49.9	18.7	19
		Total	58.9	18.9	104
	4X4 Block	■ Urban	16.8	12.2	6
		■ Suburban	49.9	17.8	28
		■ Rural	47.4	19.8	54
		Total	46.1	20.3	88
	Traditional	■ Urban	58.3	19.3	26
		■ Suburban	64.1	15.4	33
		■ Rural	56.8	16.7	35
		Total	59.8	17.2	94
	Total	■ Urban	50.4	22.9	55
		■ Suburban	61.3	17.2	123
		■ Rural	50.9	18.9	108
		Total	55.3	19.7	289

The researcher analyzed the percentage of students passing the end-of-course Geometry SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and school community. The results also suggested that there was a significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 8, Geometry Pass Rate by Scheduling Model Used, School Community.

The researcher conducted the Tukey-b post hoc test to determine the sources of the interactions. The mean pass rates for schools in urban communities using the 4X4

Table 8

Geometry Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	13474.5	2	6737.3	21.2	.000
School Community	9480.9	2	4740.5	14.9	.000
Scheduling Model*School Community	5287.7	4	1321.9	4.2	.003
Error	87875.6	277	317.2		

semester block schedule were significantly lower ($p<.05$) than those for schools using any other combination of scheduling model and school community in the study. This is presented in Table 9, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Geometry Pass Rates, and displayed graphically in Figure 10, Interaction of Scheduling Model and School Community on Geometry Pass Rates.

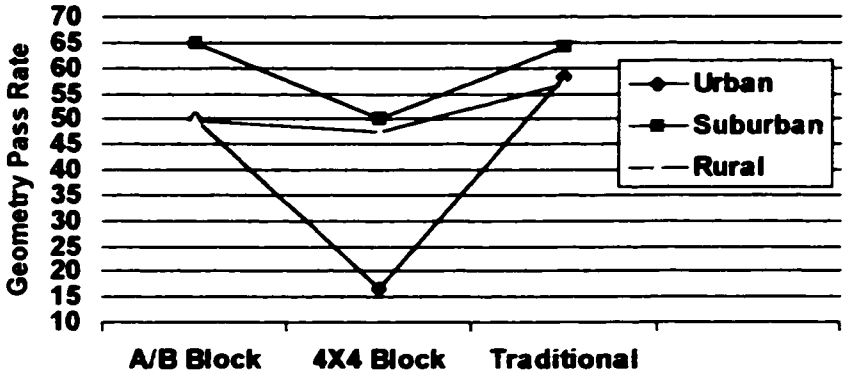
Table 9

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Geometry Pass Rates

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	16.8	
4X4 * Rural	54		47.4
A/B * Rural	19		49.9
4X4 * Suburban	28		49.9
A/B * Urban	23		50.3
Traditional * Rural	35		56.8
Traditional * Urban	26		58.3
Traditional * Suburban	33		64.1
A/B * Suburban	62		64.9

Note An asterisk (*) denotes an interaction between variables.

Figure 10. Interaction of scheduling model and school community on geometry pass. rates.



End-of-Course Algebra II Test

All but four of the 289 schools in the study administered the end-of-course Algebra II test. Taking the sample as a whole, the percentage of students passing this test ranged from zero to 100 % (M=44.9, SD=22.9). The highest pass rates were reported for schools using the traditional scheduling model (M=49.2, SD=21.5), followed by those using the A/B alternate day block schedule, which produced pass rates only slightly lower (M=48.3, SD=21.0). Schools operating under the 4X4 semester block schedule had a somewhat lower mean pass rate (M=36.5, SD=24.2). Table 10, Descriptive Statistics for Pass Rates on End-of-Course Algebra II SOL Test, reports the mean pass rates for each of the three scheduling models, broken down by type of school community.

The researcher analyzed the percentage of students passing the end-of-course Algebra II SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and

Table 10

Descriptive Statistics for Pass Rates on End-of-Course Algebra II SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Algebra II Pass Rate	A/B Alt. Day	■ Urban	47.0	22.1	23
		■ Suburban	53.9	17.9	62
		■ Rural	31.5	21.3	10
		Total	48.3	21.0	104
	4X4 Block	■ Urban	23.3	21.9	6
		■ Suburban	39.9	15.2	27
		■ Rural	36.2	27.6	55
		Total	36.5	24.2	88
		■ Urban	50.8	19.4	26
		■ Suburban	54.4	18.0	33
		■ Rural	42.8	24.9	34
		Total	49.2	21.5	93
	Total	■ Urban	46.2	22.0	55
		■ Suburban	50.9	18.2	122
		■ Rural	37.5	25.9	108
		Total	44.9	22.9	285

school community. The results also suggested that there was no significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is Summarized in Table 11, Algebra II Pass Rate by Scheduling Model Used, School Community.

Table 11

Algebra II Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	7367.2	2	3683.6	7.925	.000
School Community	8043.0	2	4021.5	8.652	.000
Scheduling Model*School Community	4377.8	4	1094.5	2.355	.054
Error	128291.5	276	464.8		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the main effects for scheduling model and school community. The mean pass rates for schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than

those for schools using either the alternate day (A/B) block scheduling or traditional models. This is displayed graphically in Table 12, Results of the Tukey's-B Test on Main Effects of Scheduling Model on Algebra II Pass Rates. Additionally, the mean pass rates for schools in rural communities were significantly lower ($p<.05$) than those in either urban or rural areas. This is displayed graphically in Table 13, Result of the Tukey's-B Test on Main Effects of School Community on Algebra II Pass Rates.

Table 12

Results of the Tukey's-B Test on Main Effects of Scheduling Model on Algebra II Pass Rates

		Subset	
Scheduling Model	N	1	2
4X4 Block	88	36.5	
A/B Block	104		48.3
Traditional Schedule	93		49.2

Table 13

Results of the Tukey's-B Test on Main Effects of School Community on Algebra II Pass Rates

		Subset	
School Community	N	1	2
Rural	108	37.5	
Urban	55		46.2
Suburban	122		50.9

End-of-Course Earth Science Test

Of the 289 schools in the study, 277 administered the end-of-course Earth Science Standards of Learning test. Taking the sample as a whole, the percentage of students at a given school passing this test ranged from zero to 100 % ($M=63.3$, $SD=16.1$). The highest pass rates were reported for schools using the traditional scheduling model ($M=65.9$, $SD=14.0$), followed by those using the alternate day (A/B) block schedule, which produced pass rates only slightly lower ($M=64.2$, $SD=16.7$). Schools operating

under the 4X4 semester block schedule had the lowest mean pass rate (M=59.6, SD=17.2). Table 14, Descriptive Statistics for Pass Rates on end-of-course Earth Science SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 14

Descriptive Statistics for Pass Rates on End-of-Course Earth Science SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Earth Science Pass Rate	A/B Alt. Day	Urban	53.0	18.3	22
		Suburban	69.7	14.0	58
		Rural	60.6	15.6	19
		Total	64.2	16.7	99
	4X4 Block	Urban	35.8	11.8	5
		Suburban	63.6	13.6	26
		Rural	59.8	17.5	55
		Total	59.6	17.2	86
	Traditional	Urban	58.7	15.3	26
		Suburban	73.0	9.4	31
		Rural	65.0	13.7	35
		Total	65.9	14.0	92
	Total	Urban	54.2	17.3	53
		Suburban	69.2	13.1	115
		Rural	61.6	16.1	109
		Total	63.3	16.1	277

The researcher analyzed the percentage of students passing the end-of-course Earth Science SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and school community. The results also suggested that there was no significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 15, Earth Science Pass Rate by Scheduling Model Used, School Community.

Table 15

Earth Science Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	3983.988	2	1991.994	9.043	.000
School Community	9581.510	2	4790.755	21.747	.000
Scheduling Model*School Community	1240.736	4	310.184	1.408	.232
Error	59038.13	268	220.292		

Note

The researcher conducted the Tukey's-b post hoc test to determine the source of the main effects of scheduling model and school community. The mean pass rates for schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for schools using traditional models. This is displayed in Table 16, Results of the Tukey's-B Test on Main Effects of Scheduling Model on Earth Science Pass Rates. When mean pass rates for school community were compared, schools in urban communities scored significantly lower ($p<.05$) than did those in either rural or suburban areas, and schools in rural areas scored significantly lower than those in suburban areas. This is displayed graphically in Table 17, Result of the Tukey-B Test on Main Effects of School Community on Earth Science Pass Rates.

Table 16

Results of the Tukey-B Test on Main Effects of Scheduling Model on Earth Science Pass Rates

Scheduling Model	N	Subset 1	Subset 2
4X4 Block	86	59.6	
A/B Block	99	64.2	64.2
Traditional Schedule	92		65.9

Table 17

Results of the Tukey's-B Test on Main Effects of School Community on Earth Science Pass Rates

		Subset		
School Community	N	1	2	3
Urban	54	54.2		
Rural	109		61.6	
Suburban	115			69.2

End-of-Course BiologyTest

All but three of the 289 schools in the study administered the end-of-course Biology Standards of Learning test. Taking the sample as a whole, the percentage of students at a given school passing this test ranged from 28.6 to 100 % (M=78.5, SD=12.1). The highest pass rates were reported for schools using the alternating day (A/B) block schedule (M=81.1, SD=11.5), followed by those using the traditional schedule, which produced pass rates only slightly lower (M=80.5, SD=10.4). Schools operating under the 4X4 semester block schedule had the lowest mean pass rate (M=73.2, SD=12.9). Table 18, Descriptive Statistics for Pass Rates on End-of-Course Biology SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

The researcher analyzed the percentage of students passing the end-of-course Biology SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the pass rates for the main effects of both scheduling model used and school community. The results also suggested a significant interaction

Table 18

Descriptive Statistics for Pass Rates on End-of-Course Biology SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Biology Pass Rate	A/B Alt. Day	Urban	74.4	15.5	23
		Suburban	85.0	7.4	62
		Rural	76.4	12.2	19
		Total	81.1	11.5	104
	4X4 Block	Urban	58.0	11.4	5
		Suburban	76.0	8.4	28
		Rural	73.1	14.1	55
		Total	53.2	12.9	88
	Traditional	Urban	79.6	10.6	26
		Suburban	85.9	6.3	33
		Rural	76.1	11.4	35
		Total	80.5	10.4	94
	Total	Urban	75.4	14.1	54
		Suburban	83.2	8.3	123
		Rural	74.7	12.9	109
		Total	78.5	12.1	286

($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 19, Biology Pass Rate by Scheduling Model Used, School Community.

Table 19

Biology Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	3455.2	2	1727.6	14.476	.000
School Community	4045.0	2	2202.5	18.583	.000
Scheduling Model*School Community	1479.0	4	369.7	3.120	.016
Error	32830.6	277	118.5		

The researcher conducted the Tukey's-b post hoc test to determine the sources of interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for all other groups in the study. This is displayed in Table 20, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Biology Pass Rates, and graphically in Figure 11, Interaction of Scheduling Model and School Community on Biology Pass Rates.

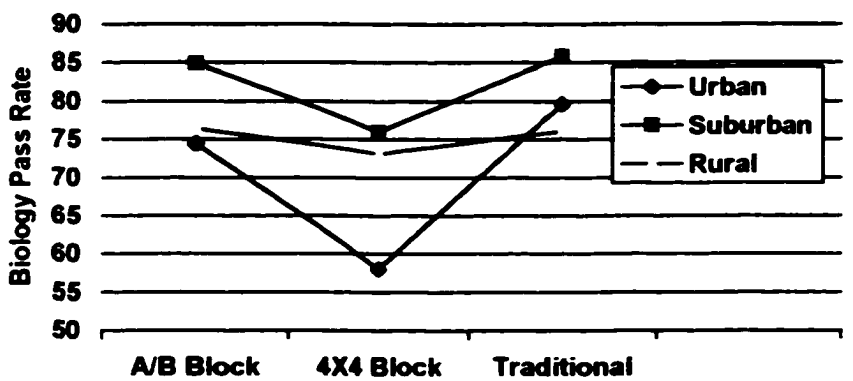
Table 20

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Biology Pass Rates

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	58.0	
4X4 * Rural	55		73.1
A/B * Urban	23		74.4
A/B * Suburban	28		76.0
Traditional * Rural	35		76.1
A/B * Rural	19		76.4
Traditional * Urban	26		79.6
A/B * Suburban	62		85.0
Traditional * Suburban	33		85.9

Note An asterisk (*) denotes an interaction between variables.

Figure 11. Interaction of scheduling model and school community on biology pass rates.



End-of-Course Chemistry Test

Of the 289 schools in the study, 281 administered the end-of-course Chemistry Standards of Learning test. Taking the sample as a whole, the percentage of students at a given school passing this test ranged from 1.6949 to 100 % (M=64.5, SD=20.7). The highest pass rates were reported for schools using the traditional schedule (M=70.7, SD=18.4). Schools using the alternate day (A/B) block schedule had the next higher mean pass rates (M=62.8, SD=21.4), followed by schools operating under the 4X4

semester block schedule (M=59.6, SD=20.9). Table 21, Descriptive Statistics for Pass Rates on End-of-Course Chemistry SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 21

Descriptive Statistics for Pass Rates on End-of-Course Chemistry SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Chemistry Pass Rate	A/B Alt. Day	Urban	62.9	29.7	23
		Suburban	65.3	17.2	62
		Rural	54.4	21.0	19
		Total	62.8	21.4	104
	4X4 Block	Urban	41.2	22.4	6
		Suburban	64.4	14.8	27
		Rural	59.1	22.5	50
		Total	59.6	20.9	83
	Traditional	Urban	66.4	22.0	26
		Suburban	75.4	12.0	33
		Rural	69.4	19.9	35
		Total	70.7	18.4	94
	Total	Urban	62.2	26.2	55
		Suburban	67.8	16.0	122
		Rural	61.7	21.9	104
		Total	64.5	20.7	281

The researcher analyzed the percentage of students passing the end-of-course Chemistry SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated a statistically significant difference ($p<.05$) in the pass rates for the main effects of both scheduling model used and school community. There was no significant interaction ($p<.05$) indicated between school community and scheduling model. The statistical analysis appears in Table 22, Chemistry Pass Rate by Scheduling Model Used, School Community.

Table 22

Chemistry Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	7911.990	2	3955.995	9.915	.000
School Community	4735.780	2	2367.890	5.935	.003
Scheduling Model*School Community	2550.845	4	637.711	1.598	.175
Error	108521.2	272	398.975		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the main effects of scheduling model and school community. The mean pass rates for schools using the traditional schedule were significantly higher ($p<.05$) than those for schools using the 4X4 semester block scheduling model. This is displayed in Table 23, Results of the Tukey's-B Test on Main Effects of Scheduling Model on Chemistry Pass Rates. When mean pass rates for school community were compared, no significant differences ($p<.05$) were found. This is displayed in Table 24, Result of the Tukey's-B Test on Main Effects of School Community on Chemistry Pass Rates.

Table 23

Results of the Tukey's-B Test on Main Effects of Scheduling Model on Chemistry Pass Rates

Scheduling Model	N	Subset 1	Subset 2
4X4 Block	83	59.6	
A/B Block	104	62.8	62.8
Traditional Schedule	94		70.7

Table 24

Results of the Tukey's-B Test on Main Effects of School Community on Chemistry Pass Rates

School Community	N	Subset 1
Rural	104	61.7
Urban	55	62.2
Suburban	122	67.8

End-of-Course United States History Test

Only two of the 289 schools in the study failed to administer the end-of-course United States History Standards of Learning test. Taking the sample as a whole, the percentage of students at a given school passing this test ranged from zero to 95.4% (M=28.9, SD=13.8). The highest pass rates were reported for schools using the alternate day (A/B) block schedule (M=32.4, SD=14.5). Schools using the traditional schedule had the next higher mean pass rates (M=29.8, SD=13.0), followed by schools operating under the 4X4 semester block schedule (M=23.9, SD=12.4). Table 25, Descriptive Statistics for Pass Rates on End-of-Course U.S. History SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

The researcher analyzed the percentage of students passing the end-of-course Chemistry SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the pass rates for the main effects of both scheduling model used and school community. There was no significant interaction ($p<.05$) indicated between school community and scheduling model. The statistical analysis is summarized in Table 26, U.S. History Pass Rate by Scheduling Model Used, School Community.

The researcher conducted the Tukey's-b post hoc test to determine interactions on the main effects of scheduling model and school community. The mean pass rates for schools using the 4X4 block schedule were significantly lower ($p<.05$) than those for

Table 25

Descriptive Statistics for Pass Rates on End-of-Course U.S. History SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
U.S. History Pass Rate	A/B Alt. Day	Urban	23.4	13.3	23
		Suburban	37.9	13.4	62
		Rural	25.4	11.0	19
		Total	32.4	15.5	104
	4X4 Block	Urban	16.5	18.1	6
		Suburban	26.8	11.5	28
		Rural	23.3	12.0	55
		Total	23.9	12.4	89
	Traditional	Urban	28.1	12.8	26
		Suburban	36.5	10.7	33
		Rural	24.7	12.9	35
		Total	29.8	13.0	94
	Total	Urban	24.9	13.8	55
		Suburban	35.0	13.0	123
		Rural	24.1	12.0	109
		Total	28.9	13.8	287

Table 26

U.S. History Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	1726.9	2	863.4	5.540	.004
School Community	5665.3	2	2832.7	18.176	.000
Scheduling Model*School Community	1354.6	4	338.6	2.173	.072
Error	43324.9	278	155.8		

Note An asterisk (*) denotes an interaction between variables.

schools using the traditional or A/B block scheduling models. This is displayed graphically in Table 27, Results of the Tukey's-B Test on Main Effects of Scheduling Model on U.S. History Pass Rates. When mean pass rates for school community were compared, pass rates among suburban schools were significantly higher ($p<.05$) than for schools in either rural or urban communities. This is displayed in Table 28, Results of the Tukey's-B Test on Main Effects of School Community on U.S. History Pass Rates.

Table 27

Results of the Tukey's-B Test on Main Effects of Scheduling Model on U.S. History Pass Rates

		Subset	
Scheduling Model	N	1	2
4X4 Block	89	23.9	
Traditional Schedule	94		29.8
A/B Block	104		32.4

Table 28

Results of the Tukey's-B Test on Main Effects of School Community on U.S. History Pass Rates

		Subset	
School Community	N	1	2
Traditional	109	24.1	
Urban	55	24.9	
Suburban	123		35.0

End-of-Course World History A Test

Far fewer schools in the Commonwealth of Virginia administered the end-of-course World History A test than any other test. Of the 185 schools in the study that administered the end-of-course World History A Standards of Learning test, the percentage of students at a given school passing this test ranged from zero to 100 % (M=64.5, SD=18.2). The highest pass rates were reported for schools using the alternating day (A/B) block schedule (M=71.1, SD=14.1), followed by those using the traditional schedule (M=66.5, SD=18.3). Schools operating under the 4X4 semester block schedule had the lowest mean pass rate (M=53.4, SD=18.4). Table 29, Descriptive Statistics for Pass Rates on End-of-Course World History A SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 29

Descriptive Statistics for Pass Rates on End-of-Course World History A SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
World History A Pass Rate	A/B Alt. Day	■ Urban	73.4	11.3	13
		■ Suburban	73.6	13.9	50
		■ Rural	57.1	10.3	11
		Total	71.1	14.1	74
	4X4 Block	■ Urban	26.4	15.8	3
		■ Suburban	58.9	14.0	18
		■ Rural	52.9	18.8	33
		Total	53.4	18.4	54
	Traditional	■ Urban	68.1	18.9	15
		■ Suburban	77.3	13.3	18
		■ Rural	57.3	16.9	24
		Total	66.4	18.3	57
		■ Urban	66.3	20.4	31
		■ Suburban	71.3	15.1	86
		■ Rural	55.1	16.9	68
		Total	64.5	18.2	185

The researcher analyzed the percentage of students passing the end-of-course World History A SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated a statistically significant difference ($p<.05$) in the pass rates for the main effects of both scheduling model used and school community. A significant interaction ($p<.05$) was also indicated between school community and scheduling model. The statistical analysis is shown in Table 30, World History A Pass Rate by Scheduling Model Used, School Community.

Table 30

World History A Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	8393.8	2	4196.9	17.728	.000
School Community	7121.1	2	3560.6	15.040	.000
Scheduling Model*School Community	4347.2	4	1086.8	4.591	.002
Error	41665.1	176	236.7		

Note An asterisk (*) denotes an interaction between variables

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for all other groups in the study. Additionally, the mean pass rate for rural schools using the 4X4 semester block schedule was significantly lower ($p<.05$) than that for suburban schools using traditional schedules. This is displayed in Table 31, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Biology Pass Rates, and graphically in Figure 12, Interaction of Scheduling Model and School Community on World History A Pass Rates.

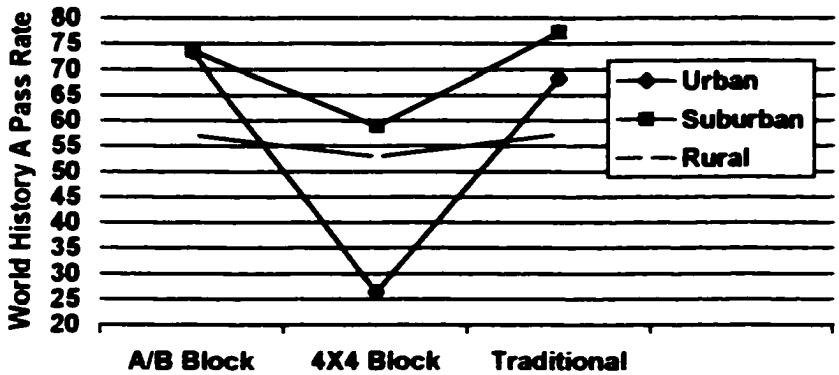
Table 31

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History A Pass Rates

Scheduling Model * School Community	N	Subset 1	Subset 2	Subset 3
4X4 * Urban	3	26.4		
4X4 * Rural	33		52.9	
A/B * Rural	11		57.1	57.1
Traditional * Rural	24		57.3	57.3
4X4 * Suburban	18		58.9	58.9
Traditional * Urban	15		68.1	68.1
A/B * Urban	13		73.4	73.4
A/B * Suburban	50		73.6	73.6
Traditional * Suburban	18			77.3

Note An asterisk (*) denotes an interaction between variables.

Figure 12. Interaction of scheduling model and school community on world history A pass rates.



End-of-Course World History B Test

Of the 289 schools in the study, 235 administered the end-of-course World History B Standards of Learning test. Taking the sample as a whole, the percentage of students at a given school passing this test ranged from zero to 100 % (M=45.0, SD=23.6). The highest pass rates were reported for schools using the alternate day (A/B) block schedule (M=49.3, SD=24.6), followed by those using the traditional schedule, which produced pass rates slightly lower (M=47.4, SD=23.0). Schools operating under the 4X4 semester block schedule had the lowest mean pass rate (M=37.2, SD=21.2). Table 32, Descriptive Statistics for Pass Rates on End-of-Course World History B SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

The researcher analyzed the percentage of students passing the end-of-course World History SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a

Table 32

Descriptive Statistics for Pass Rates on End-of-Course World History B SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
World History B Pass Rate	A/B Alt. Day	■ Urban	35.7	17.5	21
		■ Suburban	59.5	23.1	57
		■ Rural	26.1	11.7	13
		Total	49.3	24.6	91
	4X4 Block	■ Urban	13.7	9.6	5
		■ Suburban	43.6	19.1	24
		■ Rural	36.4	21.5	43
		Total	37.2	21.2	72
	Traditional	■ Urban	38.7	20.4	21
		■ Suburban	57.5	24.6	31
		■ Rural	41.0	17.1	20
		Total	47.4	23.0	72
	Total	■ Urban	34.7	19.5	47
		■ Suburban	55.5	23.5	112
		■ Rural	35.9	19.4	76
		Total	45.0	23.6	235

statistically significant difference ($p<.05$) in the pass rates for the main effects of both scheduling model used and school community. The results also suggested a significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 33, World History B Pass Rate by Scheduling Model Used, School Community.

Table 33

World History B Pass Rate by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	4807.411	2	2403.705	5.543	.004
School Community	20824.41	2	10412.21	24.011	.000
Scheduling Model*School Community	5442.131	4	1360.533	3.137	.015
Error	98002.40	226	433.639		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interactions. The mean pass rates for urban schools using the 4X4 semester block

schedule were significantly lower ($p<.05$) than those for all suburban schools in the study, regardless of the scheduling model used. Additionally, the mean pass rates for rural schools using the alternate day (A/B) schedule are significantly lower ($p<.05$) than suburban schools using either traditional or the alternate day (A/B) scheduling models. This is displayed in Table 34, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History B Pass Rates, and depicted graphically in Figure 13, Interaction of Scheduling Model and School Community on World History B Pass Rates.

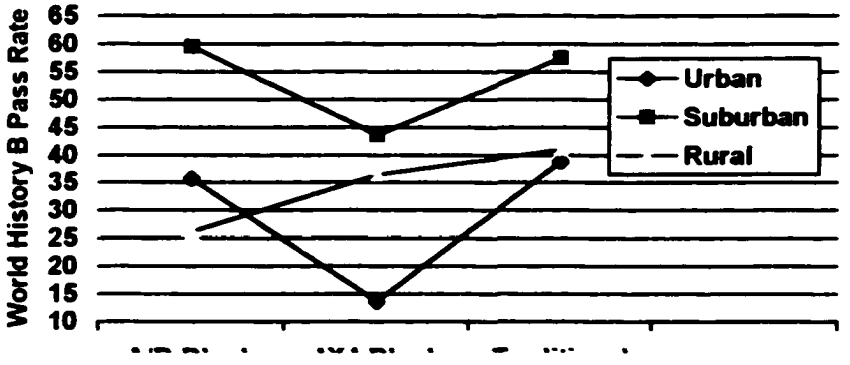
Table 34

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History B Pass Rates

Scheduling Model * School Community	N	Subset 1	2	3
4X4 * Urban	5	13.7		
A/B * Rural	13	26.1	26.1	
A/B * Urban	21	35.7	35.7	35.7
4X4 * Rural	43	36.4	36.4	36.4
Traditional * Urban	21	38.8	38.8	38.8
Traditional * Rural	20	41.0	41.0	41.0
4X4 * Suburban	24		43.6	43.6
Traditional * Suburban	31			57.5
A/B * Suburban	57			59.5

Note An asterisk (*) denotes an interaction between variables.

Figure 13. Interaction of scheduling model and school community on World History B pass rates.



Mean Scaled Scores

The mean scaled scores for each of the public high schools in Virginia administering the end-of-course Standards of Learning tests in 1998-99 were obtained from the Virginia Department of Education via e-mail. As with the percentage of students passing the tests, the mean scaled scores for each school varied widely. Theoretically, these mean scores could range from zero to 600, with 400 as the passing score.

End-of-Course Algebra I Test

Among the 284 schools in the sample that administered the end-of-course Algebra I Test, the mean scaled scores ranged from a low of 323.0 to a high of 483.8 (M=395.2, SD=21.6). When broken down by scheduling model, fewer than 5 points separated the highest scoring group (traditional scheduling model) from the lowest scoring (4X4 semester block schedule). Schools using the traditional scheduling model scored the highest (M=398.2, SD=20.8), followed by those using the alternate day (A/B) block schedule (M=393.9, SD= 22.1), and those using the 4X4 semester block model (M=393.5, SD= 21.6). Table 35, Descriptive Statistics for Mean Scaled Scores on End-of-Course Algebra I SOL Test, reports the mean scaled scores for each of the scheduling models, subdivided by type of school community.

The researcher analyzed the mean scaled scores for each high school which administered the end-of-course Algebra I Standards of Learning test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the mean scaled score. The results indicated that there was a statistically significant difference ($p<.05$) in the scaled

Table 35

Descriptive Statistics for Mean Scaled Scores on End-of-Course Algebra I SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Algebra I Test Score	A/B Alt. Day	Urban	387.9	20.0	23
		Suburban	397.2	23.4	59
		Rural	390.6	19.1	19
		Total	393.9	22.1	101
	4X4 Block	Urban	364.7	10.3	5
		Suburban	394.0	19.2	28
		Rural	395.9	21.8	56
		Total	393.5	21.6	89
	Traditional	Urban	399.2	17.9	26
		Suburban	400.4	22.7	33
		Rural	395.4	21.3	35
		Total	398.2	20.8	94
	Total	Urban	391.2	20.7	54
		Suburban	397.3	22.2	120
		Rural	394.8	21.1	110
		Total	395.2	21.6	284

scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 36, Algebra I Test Score by Scheduling Model Used, School Community.

Table 36

Algebra I Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	4981.1	2	2490.6	5.540	.004
School Community	4330.3	2	2165.2	4.816	.009
Scheduling Model*School Community	4668.5	4	1167.1	2.596	.037
Error	123634.0	275	449.6		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than all schools using the traditional scheduling model, as well as for suburban schools using the alternate day (A/B) block, and suburban

and rural schools using the 4X4 semester block model. This is displayed in Table 37, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra I SOL Test Scores, and depicted graphically in Figure 14, Interaction of Scheduling Model and School Community on Algebra I SOL Test Scores.

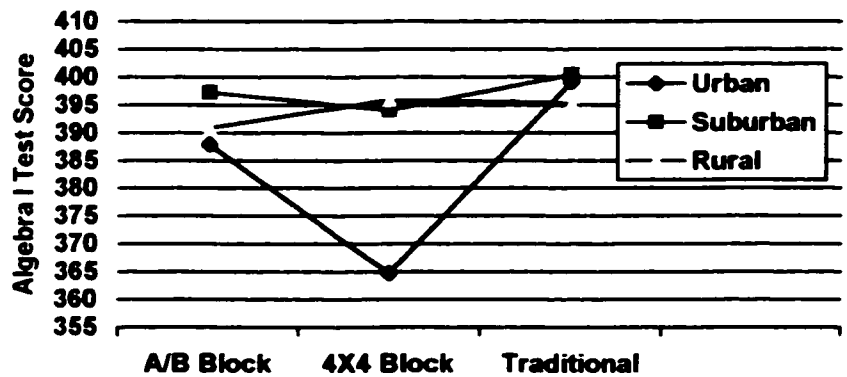
Table 37

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra I SOL Test Scores

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	364.7	
A/B * Urban	23	387.9	387.9
A/B * Rural	19	390.6	390.6
4X4 * Suburban	28		394.0
Traditional * Rural	35		395.4
4X4 * Rural	56		395.9
A/B * Suburban	59		397.2
Traditional * Urban	26		399.2
Traditional * Suburban	33		400.4

Note An asterisk (*) denotes an interaction between variables.

Figure 14. Interaction of scheduling model and school community on algebra I SOL test scores



End-of-Course Geometry Test

Among the 286 schools in the sample that administered the end-of-course Geometry SOL Test, the mean scaled scores ranged from a low of 354.3 to a high of 520.2 (M=410.8, SD=22.8). Schools using the A/B alternate day block schedule scored the highest (M=415.7, SD= 24.1), followed by those using the traditional scheduling model (M=415.3, SD=22.8), and those using the 4X4 semester block model (M=400.2, SD= 20.4). Table 38, Descriptive Statistics for Mean Scaled Scores on End-of-Course Geometry SOL Test, reports the mean scaled scores for each of the three scheduling models, subdivided by type of school community.

Table 38

Descriptive Statistics for Mean Scaled Scores on End-of-Course Geometry SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Geometry Test Score	A/B Alt. Day	Urban	404.6	22.0	23
		Suburban	423.2	23.0	62
		Rural	404.7	21.1	19
		Total	415.7	24.1	104
	4X4 Block	Urban	372.1	14.5	6
		Suburban	404.9	19.3	28
		Rural	400.8	19.4	54
		Total	400.2	20.4	88
	Traditional	Urban	414.5	22.1	26
		Suburban	419.7	18.2	33
		Rural	411.7	20.4	35
		Total	415.3	20.2	94
	Total	Urban	405.8	24.6	55
		Suburban	418.1	22.1	123
		Rural	405.0	20.4	108
		Total	410.8	22.8	286

The researcher analyzed the mean scaled scores for each high school that administered the end-of-course Geometry Standards of Learning test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the mean scaled score. The

results indicated that there was a statistically significant difference ($p<.05$) in the scaled scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 39, Geometry Test Score by Scheduling Model Used, School Community.

Table 39

Geometry Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	14891.0	2	7445.5	17.356	.000
School Community	11342.2	2	5671.1	13.220	.000
Scheduling Model*School Community	5852.3	4	1463.1	3.411	.010
Error	118828.2	277	429.0		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than for all other subgroups in the study. This is displayed in Table 40, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Geometry SOL Test Scores, and depicted graphically in Figure 15, Interaction of Scheduling Model and School Community on Geometry SOL Test Scores.

End-of-Course Algebra II Test

Among the 285 schools in the sample that administered the end-of-course Algebra II SOL Test, the mean scaled scores ranged from a low of 320.6 to a high of 518.4 (M=397.5, SD=31.0). Schools using the traditional scheduling model scored the highest (M=403.2, SD= 28.2), followed by those using the A/B alternate day block

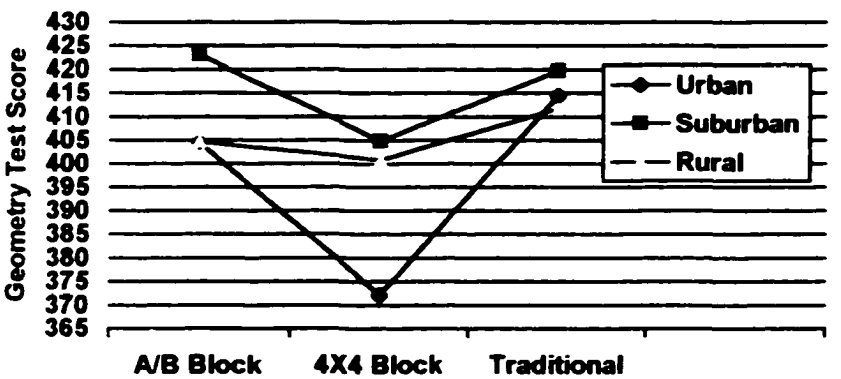
Table 40

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Geometry SOL Test Scores

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	6	372.1	
4X4 * Rural	54		400.3
A/B * Urban	23		404.6
A/B * Rural	19		404.7
4X4 * Suburban	28		404.9
Traditional * Rural	35		411.7
Traditional * Urban	26		414.6
Traditional * Suburban	33		419.7
A/B * Suburban	62		423.2

Note An asterisk (*) denotes an interaction between variables.

Figure 15. Interaction of scheduling model and school community on geometry SOL test scores



schedule (M=401.6, SD=29.3), and those using the 4X4 semester block model (M=386.7, SD=33.4). Table 41, Descriptive Statistics for Mean Scaled Scores on End-of-Course Algebra II SOL Test, reports the mean scaled scores for each of the three scheduling models, further subdivided by type of school community.

The researcher analyzed the mean scaled scores for each high school that administered the end-of-course Algebra II Standards of Learning test using a 3X3

Table 41

Descriptive Statistics for Mean Scaled Scores on End-of-Course Algebra II SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Algebra II Test Score	A/B Alt. Day	Urban	398.2	29.0	23
		Suburban	409.4	26.5	62
		Rural	380.3	28.2	19
		Total	401.6	29.3	104
	4X4 Block	Urban	363.3	26.2	6
		Suburban	390.0	17.0	27
		Rural	387.6	39.1	55
		Total	386.7	33.4	88
	Traditional	Urban	403.7	22.4	26
		Suburban	410.2	23.6	33
		Rural	395.9	34.6	34
		Total	403.2	28.2	93
	Total	Urban	397.1	27.9	55
		Suburban	405.3	25.1	122
		Rural	395.9	36.1	108
		Total	397.5	31.0	285

analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the mean scaled score. The results indicated that there was a statistically significant difference ($p<.05$) in the scaled scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 42, Algebra II Test Score by Scheduling Model Used, School Community.

Table 42

Algebra II Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	14468.59	2	7234.294	8.357	.000
School Community	13172.34	2	6586.172	7.609	.001
Scheduling Model*School Community	9153.798	4	2288.450	2.644	.034
Error	238913.3	276	865.628		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than for those at suburban schools using either the traditional schedule or the alternate day (A/B) block schedule. This is displayed in Table 43, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra II SOL Test Scores, and depicted graphically in Figure 16, Interaction of Scheduling Model and School Community on Algebra II SOL Test Scores..

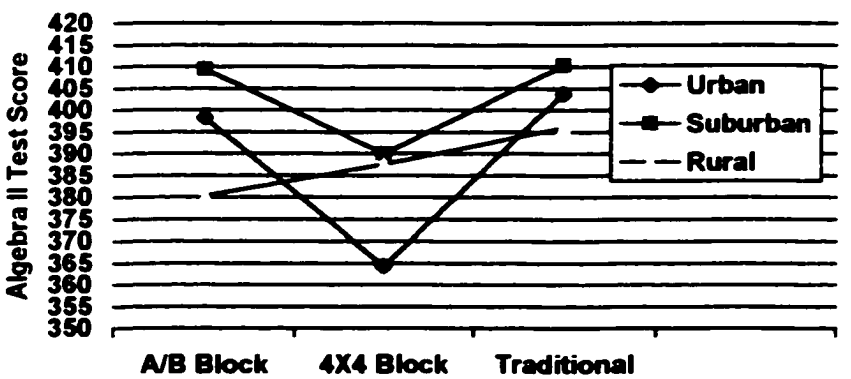
Table 43

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Algebra II SOL Test Scores

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	6	387.6	
A/B * Rural	19	380.3	380.3
4X4 * Rural	55	387.6	387.6
4X4 * Suburban	27	390.0	390.0
Traditional * Rural	34	395.9	395.9
A/B * Urban	23	398.2	398.2
Traditional * Urban	26	403.7	403.7
A/B * Suburban	62		409.4
Traditional * Suburban	33		410.2

Note An asterisk (*) denotes an interaction between variables.

Figure 16. Interaction of scheduling model and school community on algebra II SOL test scores.



End-of-Course Earth Science Test

Of the 289 schools in the study, 277 administered the end-of-course Earth Science Standards of Learning test. Taking the sample as a whole, the mean scaled scores ranged from 360.7 to 508.2 (M=419.6, SD=19.8). The highest mean scaled scores were reported for schools using the traditional scheduling model (M=422.0, SD=17.1), followed by those using the A/B alternating day block schedule, which produced scaled scores only slightly lower (M=421.2, SD=21.4). Schools operating under the 4X4 semester block schedule had the lowest mean scaled scores (M=415.0, SD=20.1). Table 44, Descriptive Statistics for Pass Rates on End-of-Course Earth Science SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 44

Descriptive Statistics for Mean Scaled Scores on End-of-Course Earth Science SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Earth Science Pass Rate	A/B Alt. Day	■ Urban	407.9	19.7	22
		■ Suburban	428.0	20.6	58
		■ Rural	415.6	17.6	19
		Total	421.2	21.4	99
	4X4 Block	■ Urban	387.2	12.8	5
		■ Suburban	421.1	19.2	26
		■ Rural	414.7	19.1	55
		Total	415.0	20.1	86
	Traditional	■ Urban	414.2	17.5	26
		■ Suburban	431.2	13.3	31
		■ Rural	419.8	16.5	35
		Total	422.0	17.1	92
	Total	■ Urban	409.0	19.4	53
		■ Suburban	427.3	18.8	115
		■ Rural	416.5	18.0	109
		Total	419.6	19.8	277

The researcher analyzed the mean scaled scores for schools using the end-of-course Earth Science SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent

variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and school community. The results also suggested that there was no significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 45, Earth Science Test Score by Scheduling Model Used, School Community.

Table 45

Earth Science Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	5003.932	2	2501.966	7.484	.001
School Community	14670.38	2	7335.192	21.942	.000
Scheduling Model*School Community	1854.713	4	463.678	1.387	.239
Error	89594.06	268	334.306		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the main effects for scheduling model and school community. The mean pass rates for schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for schools using traditional models. This is displayed in Table 46, Results of the Tukey's-B Test on Main Effects of Scheduling Model on Earth Science Test Scores. When mean pass rates for school community were compared, schools in urban communities scored significantly lower ($p<.05$) than did those in either rural or suburban areas, and schools in rural areas scored significantly lower ($p<.05$) than those in suburban areas. This is displayed in Table 47, Results of the Tukey's-B Test on Main Effects of School Community on Earth Science Test Scores.

Table 46

Results of the Tukey-B Test on Main Effects of Scheduling Model on Earth Science Test Scores

Scheduling Model	N	Subset 1	Subset 2
4X4 Block	86	415.0	
A/B Block	99		421.2
Traditional Schedule	92		422.0

Table 47

Results of the Tukey's-B Test on Main Effects of School Community on Earth Science Test Scores

School Community	N	Subset 1	Subset 2	Subset 3
Urban	54	409.0		
Rural	109		416.5	
Suburban	115			427.3

End-of-Course Biology Test

Among the 286 schools in the sample that administered the end-of-course Biology SOL Test, the mean scaled scores ranged from 385.0 to 508.7 (M=431.3, SD=16.1). Schools using the A/B alternate day block schedule scored the highest (M=435.4, SD=16.4), followed by those using the traditional scheduling mode (M=433.9, SD=14.7), and those using the 4X4 semester block model (M=423.8, SD=14.7). Table 48, Descriptive Statistics for Mean Scaled Scores on End-of-Course Biology SOL Test, reports the mean scaled scores for each of the three scheduling models, subdivided by type of school community.

The researcher analyzed the mean scaled scores for each high school that administered the end-of-course Biology Standards of Learning test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of

Table 48

Descriptive Statistics for Mean Scaled Scores on End-of-Course Biology SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Biology Test Score	A/B Alt. Day	Urban	427.4	18.0	23
		Suburban	440.5	14.4	62
		Rural	428.4	14.5	19
		Total	435.4	16.4	104
	4X4 Block	Urban	405.0	10.9	5
		Suburban	426.6	10.3	28
		Rural	424.1	15.7	55
		Total	423.8	14.7	88
	Traditional	Urban	433.1	14.3	26
		Suburban	442.0	11.7	33
		Rural	426.8	14.0	34
		Total	433.7	14.7	93
	Total	Urban	428.1	17.4	54
		Suburban	437.7	14.2	123
		Rural	425.7	14.9	109
		Total	431.3	16.1	286

school community, and the dependent variable was the mean scaled score. The results indicated that there was a statistically significant difference ($p<.05$) in the scaled scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 49, Biology Test Score by Scheduling Model Used, School Community.

Table 49

Biology Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	6352.0	2	3176.0	15.596	.000
School Community	7629.7	2	3814.9	18.733	.000
Scheduling Model*School Community	3149.0	4	787.3	3.866	.004
Error	56409.5	277	203.6		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the interactions. The mean pass rates for urban schools using the 4X4 semester block

schedule were significantly lower ($p<.05$) than for suburban schools using the 4X4 semester block schedule and for schools using either the traditional or alternated day (A/B) schedule, regardless of the school community in which the schools are located. This is displayed in Table 50, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Biology SOL Test Scores, and depicted graphically in Figure 17, Interaction of Scheduling Model and School Community on Biology SOL Test Scores.

Table 50

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on Biology SOL Test Scores

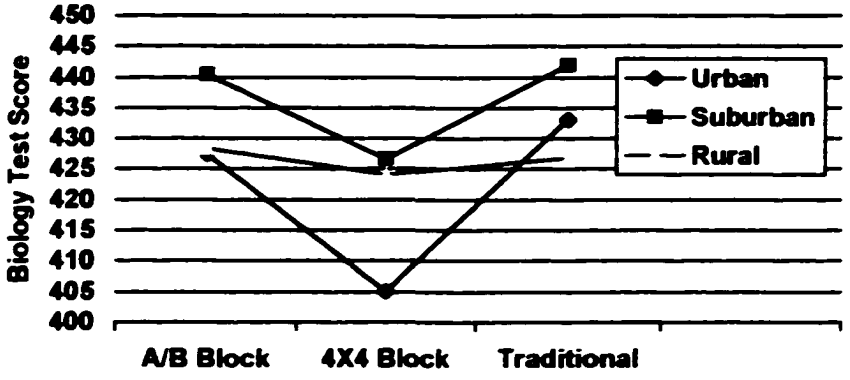
Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	405.0	
4X4 * Rural	55	424.1	424.1
4X4 * Suburban	28		426.6
Traditional * Rural	35		426.8
A/B * Urban	23		427.3
A/B * Rural	19		428.4
Traditional * Urban	26		433.1
A/B * Suburban	62		440.5
Traditional * Suburban	33		442.0

Note An asterisk (*) denotes an interaction between variables.

End-of-Course Chemistry Test

Among the 281 schools in the study that administered the end-of-course Chemistry Standards of Learning test, the mean scaled scores ranged from 350.5 to 499.4 (M=414.8, SD=20.8). The highest mean scaled scores were reported for schools using the traditional scheduling model (M=421.5, SD=19.4), followed by those using the A/B alternating day block schedule (M=413.8, SD=22.4). Schools operating under the 4X4 semester block schedule had the lowest mean scaled scores (M=408.2, SD=20.0). Table

Figure 17. Interaction of scheduling model and school community on biology SOL test scores.



51, Descriptive Statistics for Pass Rates on End-of-Course Chemistry SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 51

Descriptive Statistics for Mean Scaled Scores on End-of-Course Chemistry SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
Chemistry Pass Rate	A/B Alt. Day	Urban	415.0	31.5	23
		Suburban	416.2	19.4	62
		Rural	404.7	16.3	19
		Total	413.8	22.4	104
	4X4 Block	Urban	388.0	19.7	6
		Suburban	412.9	15.4	27
		Rural	408.2	21.0	50
		Total	408.2	20.0	83
	Traditional	Urban	420.3	19.7	26
		Suburban	426.1	16.3	33
		Rural	418.1	16.7	35
		Total	421.5	17.6	94
	Total	Urban	414.6	26.7	55
		Suburban	418.1	18.4	122
		Rural	410.9	19.4	104
		Total	414.8	20.8	281

The researcher analyzed the mean scaled scores for schools using the end-of-course Chemistry SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent

variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and school community. The results also suggested that there was no significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 52, Chemistry Test Score by Scheduling Model Used, School Community.

Table 52

Chemistry Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	10316.49	2	5158.243	13.107	.000
School Community	4666.993	2	2333.496	5.929	.003
Scheduling Model*School Community	3316.725	4	829.181	2.107	.080
Error	107044.3	272	393.545		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the main effects for scheduling model and school community. The mean pass rates for schools using the traditional schedule were significantly higher ($p<.05$) than those for schools using either alternate day (A/B) block or 4X4 semester block scheduling models. This is displayed in Table 53, Results of the Tukey's-B Test on Main Effects of Scheduling Model on Chemistry Test Scores. When mean pass rates for school community were compared, schools in rural communities scored significantly lower ($p<.05$) than did those in suburban areas. This is displayed in Table 54, Results of the Tukey's-B Test on Main Effects of School Community on Chemistry Test Scores.

Table 53

Results of the Tukey's-B Test on Main Effects of Scheduling Model on Chemistry Test Scores

		Subset	
Scheduling Model	N	1	2
4X4 Block	83	408.2	
A/B Block	104	413.8	
Traditional Schedule	94		421.5

Table 54

Results of the Tukey's-B Test on Main Effects of School Community on Chemistry Test Scores

		Subset	
School Community	N	1	2
Rural	104	410.9	
Urban	55	414.56	414.6
Suburban	122		418.1

End-of-Course United States History Test

Among the 288 schools in the study that administered the end-of-course U. S. History Standards of Learning test, the mean scaled scores ranged from 311.7 to 479.6 (M=374.7, SD=20.3). The highest mean scaled scores were reported for schools using the alternate day (A/B) day block schedule (M=379.5, SD=21.3), followed by those using the traditional scheduling model (M=376.6, SD=17.5). Schools operating under the 4X4 semester block schedule had the lowest mean scaled scores (M=367.1, SD=19.8). Table 55, Descriptive Statistics for Pass Rates on End-of-Course U.S. History SOL Test, reports the mean pass rates for each of the scheduling models, broken down by type of school community.

Table 55

Descriptive Statistics for Mean Scaled Scores on End-of-Course U.S. History SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
U.S. History Scaled Score	A/B Alt. Day	■ Urban	367.5	19.6	23
		■ Suburban	387.3	19.8	62
		■ Rural	368.5	16.6	19
		Total	379.5	21.3	104
	4X4 Block	■ Urban	353.0	32.9	6
		■ Suburban	371.8	17.6	28
		■ Rural	366.3	18.8	56
		Total	367.1	19.8	90
	Traditional	■ Urban	373.6	18.3	26
		■ Suburban	385.3	13.9	33
		■ Rural	370.5	17.0	35
		Total	376.6	17.5	94
	Total	■ Urban	368.8	21.3	55
		■ Suburban	383.2	18.8	123
		■ Rural	368.0	17.8	110
		Total	374.7	20.3	288

The researcher analyzed the mean scaled scores for schools that administered the end-of-course U. S. History SOL test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the percentage of students passing. The results indicated that there was a statistically significant difference ($p<.05$) in the main effects of both scheduling model used and school community. The results also suggested that there was no significant interaction ($p<.05$) between school community and scheduling model. The statistical analysis is summarized in Table 56, U.S. History Test Score by Scheduling Model Used, School Community.

The researcher conducted the Tukey's-b post hoc test to determine the sources of the main effects of scheduling model and school community. The mean pass rates for schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than those for schools using either traditional or alternate day (A/B) semester block scheduling

Table 56

U.S. History Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	4788.4	2	2394.2	7.036	.001
School Community	12035.6	2	6017.8	17.685	.000
Scheduling Model*School Community	2527.5	4	631.7	1.857	.118
Error	94936.5	279	340.3		

Note An asterisk (*) denotes an interaction between variables.

models. This is displayed graphically in Table 57, Results of the Tukey's-B Test on Main Effects of Scheduling Model on U.S. History Test Scores. When mean pass rates for school community were compared, schools in suburban communities scored significantly higher ($p<.05$) than did those in either urban or rural areas. This is displayed graphically in Table 58, Results of the Tukey's-B Test on Main Effects of School Community on U.S. History Test Scores.

Table 57

Results of the Tukey's-B Test on Main Effects of Scheduling Model on U.S. History Test Scores

		Subset	
Scheduling Model	N	1	2
4X4 Block	90	367.1	
Traditional	94		376.6
A/B Block	104		379.5

Table 58

Results of the Tukey's-B Test on Main Effects of School Community on U.S. History Test Scores

		Subset	
School Community	N	1	2
Rural	110	368.0	
Urban	55	368.8	
Suburban	123		383.2

End-of-Course World History A Test

Among the 185 schools in the sample that administered the end-of-course World History A SOL Test, the mean scaled scores ranged from 344.7 to 498.7 (M=417.0, SD=20.9). Schools using the A/B alternate day block schedule scored the highest (M=424.2, SD=17.3), followed by those using the traditional scheduling model (M=418.8, SD=22.9), and those using the 4X4 semester block model (M=405.5, SD=18.3). Table 59, Descriptive Statistics for Mean Scaled Scores on End-of-Course World History A SOL Test, reports the mean scaled scores for each of the three scheduling models, subdivided by type of school community.

Table 59

Descriptive Statistics for Mean Scaled Scores on End-of-Course World History A SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
World History A	A/B Alt. Day	Urban	425.8	13.0	13
		Suburban	427.1	17.9	50
		Rural	408.8	10.4	11
		Total	424.2	17.3	74
	4X4 Block	Urban	379.9	13.9	3
		Suburban	409.7	14.6	18
		Rural	405.4	18.9	33
		Total	405.5	18.3	54
	Traditional	Urban	422.6	27.6	15
		Suburban	430.5	21.7	18
		Rural	407.6	14.6	24
		Total	418.8	22.9	57
		Urban	419.8	24.8	31
		Suburban	424.2	19.5	86
		Rural	406.7	16.2	68
		Total	417.0	20.9	185

The researcher analyzed the mean scaled scores for each high school that administered the end-of-course World History A Standards of Learning test using a 3X3 analysis of variance, where the independent variables were scheduling model used and

type of school community, and the dependent variable was the mean scaled score. The results indicated that there was a statistically significant difference ($p<.05$) in the scaled scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 60, World History A Test Score by Scheduling Model Used, School Community.

Table 60

World History A Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	8622.6	2	4311.3	13.126	.000
School Community	7664.9	2	3832.4	11.669	.000
Scheduling Model*School Community	5070.6	4	1267.7	3.860	.005
Error	57805.9	176	328.4		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine the source of the interactions. The mean pass rates for urban schools using the 4X4 semester block schedule were significantly lower ($p<.05$) than for any other subgroup in the study. Furthermore, the test indicated that mean scaled scores for rural schools using the 4X4 semester block schedules are significantly lower ($p<.05$) than for suburban schools using traditional schedules. This is displayed in Table 60, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History A SOL Test Scores, and depicted graphically in Figure 18, Interaction of Scheduling Model and School Community on World History A SOL Test Scores.

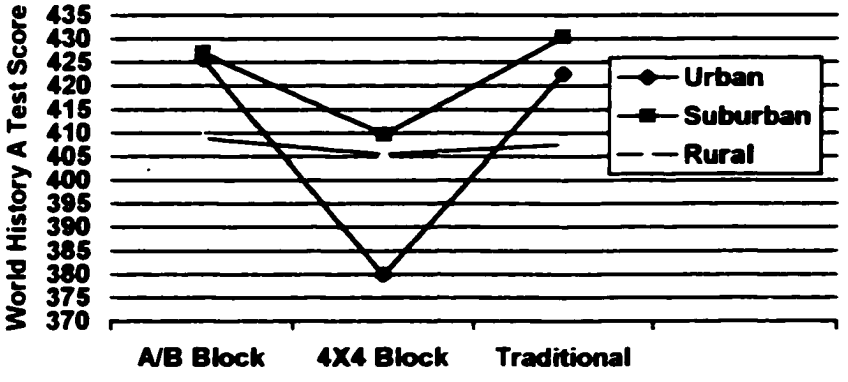
Table 61

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History A SOL Test Scores

Scheduling Model * School Community	N	Subset 1	2	3
4X4 * Urban	3	379.9		
4X4 * Rural	33		405.4	
Traditional * Rural	24		407.6	407.6
A/B * Rural	11		408.8	408.8
4X4 * Suburban	18		409.7	409.7
Traditional * Urban	15		422.6	422.6
A/B * Urban	13		425.8	425.8
A/B * Suburban	50		427.1	427.1
Traditional * Suburban	18			430.5

Note An asterisk (*) denotes an interaction between variables.

Figure 18. Interaction of scheduling model and school community on world history A SOL test scores.



End-of-Course World History B Test

Among the 235 schools in the sample that administered the end-of-course World History B SOL Test, the mean scaled scores ranged from 338.4 to 530.5 (M=401.1, SD=28.0). Schools using the A/B alternate day block schedule scored the highest (M=407.3, SD=32.3), followed by those using the traditional scheduling model (M=403.6, SD=27.1), and those using the 4X4 semester block model (M=390.8,

SD=18.2). Table 62, Descriptive Statistics for Mean Scaled Scores on End-of-Course World History B SOL Test, reports the mean scaled scores for each of the three scheduling models, subdivided by type of school community.

Table 62

Descriptive Statistics for Mean Scaled Scores on End-of-Course World History B SOL Test

	Scheduling Model Used	School Community	Mean	Standard Deviation	N
World History B Test Score	A/B Alt. Day	Urban	392.2	19.2	21
		Suburban	419.1	33.3	57
		Rural	379.8	13.7	13
		Total	407.3	32.3	91
	4X4 Block	Urban	368.1	10.5	5
		Suburban	395.7	19.3	24
		Rural	390.7	18.2	43
		Total	390.8	19.2	72
	Traditional	Urban	394.4	22.5	21
		Suburban	415.5	30.2	31
		Rural	394.9	19.2	20
		Total	403.6	27.1	72
		Urban	390.7	21.3	47
		Suburban	413.1	31.1	112
		Rural	390.0	18.2	76
		Total	401.1	28.0	235

The researcher analyzed the mean scaled scores for each high school that administered the end-of-course World History B Standards of Learning test using a 3X3 analysis of variance, where the independent variables were scheduling model used and type of school community, and the dependent variable was the mean scaled score. The results indicated that there was a statistically significant difference ($p<.05$) in the scaled scores for the main effects of both school community and scheduling model. The analysis further revealed a significant interaction between scheduling model and school community. The statistical analysis is summarized in Table 63, World History B Test Score by Scheduling Model Used, School Community.

Table 63

World History B Test Score by Scheduling Model Used, School Community

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Scheduling Model	6441.2	2	3220.5	5.236	.006
School Community	24783.4	2	12391.7	20.148	.000
Scheduling Model*School Community	8319.8	4	2079.9	3.382	.010
Error	138998.0	226	615.0		

Note An asterisk (*) denotes an interaction between variables.

The researcher conducted the Tukey's-b post hoc test to determine interactions. The mean pass rates for suburban schools using either the alternate day (A/B) block schedule or the traditional scheduling model were significantly higher ($p<.05$) than for either rural schools using the alternate day (A/B) block schedule, or for urban schools using the 4X4 semester block schedules. This is displayed in Table 64, Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History B SOL Test Scores, and depicted graphically in Figure 19, Interaction of Scheduling Model and School Community on World History B SOL Test Scores.

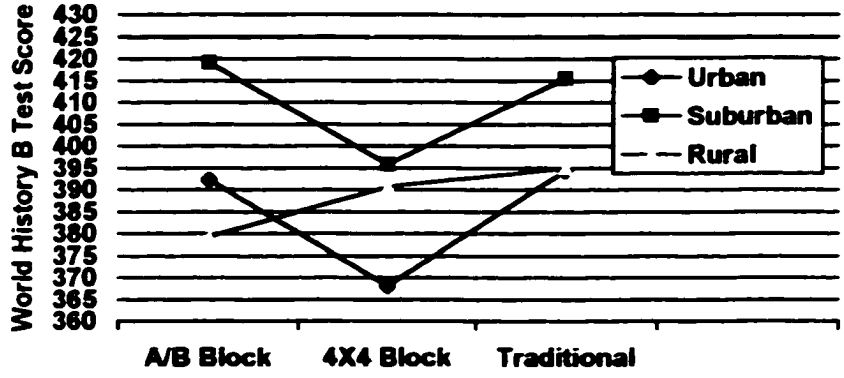
Table 64

Results of the Tukey's-B Test on Interaction of Scheduling Model and School Community on World History B SOL Test Scores

Scheduling Model * School Community	N	Subset 1	Subset 2
4X4 * Urban	5	368.1	
A/B * Rural	13	379.8	
4X4 * Rural	43	390.7	390.7
A/B * Urban	21	392.2	392.2
Traditional * Urban	21	394.4	394.4
Traditional * Rural	20	394.9	394.9
4X4 * Suburban	24	395.7	395.7
Traditional * Suburban	31		415.5
A/B * Suburban	57		419.1

Note An asterisk (*) denotes an interaction between variables.

Figure 19. Interaction of scheduling model and school community on world history B SOL test scores.



Summary of Findings

This study was designed to determine whether the scheduling model adopted by a high school has a significant impact on the rate at which students pass and/or the mean scaled scores achieved by students on Virginia's end-of-course Standards of Learning tests. The study further investigated whether the pass rates and test scores on the same tests were impacted by an interaction of scheduling model and the urbanicity of the school. The researcher used each of the high schools in the Commonwealth of Virginia that operated on one of three scheduling models: 4X4 semester block schedule, alternate day (A/B) block schedule, or the traditional six- or seven-class period daily schedule. The dependent variables in the study were pass rates and mean scaled scores on Virginia's end-of-course Standards of Learning tests in the following subjects: Algebra I, Geometry, Algebra II, Earth Science, Biology, Chemistry, U. S. History, World History A, and World History B. The findings of the study as they address each of the research questions are summarized below.

Research Question 1: Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method and/or the traditional six- or seven-class period day scheduling models?

Analysis of the data gathered for this study indicates that there was a significant difference ($p<.05$) in the pass rates based upon the type of schedule used on every measure tested with the exception of the end-of-course Algebra I Standards of Learning Assessment. This is summarized in Table 65, Summary of Findings, Main Effects of Scheduling Model on End-of-Course Standards of Learning Pass Rates.

Table 65

Summary of Findings, Main Effects of Scheduling Model on End-of-Course Standards of Learning Pass Rates

	Mean Pass Rate (%)			
End-of Course SOL Test Measure	A/B Block Schedule	4X4 Block Schedule	Traditional Schedule	Significant Difference ($p<.05$)
Algebra I	38.6	38.0	42.8	Not significant
Geometry	58.9	46.1	59.8	4X4 significantly lower than A/B & traditional models
Algebra II	48.3	36.5	49.2	4X4 significantly lower than A/B & traditional models
Earth Science	64.2	59.6	65.9	4X4 significantly lower than traditional model; no significant differences between A/B & either 4X4 or traditional models
Biology	81.1	53.2	80.5	4X4 significantly lower than A/B & traditional models
Chemistry	62.8	59.6	70.7	Both 4X4 & A/B significantly lower than traditional model
U.S. History	32.4	23.9	29.8	4X4 significantly lower than A/B & traditional models
World History A	71.1	53.4	66.5	4X4 significantly lower than A/B & traditional models
World History B	49.2	37.2	47.4	4X4 significantly lower than A/B & traditional models

On both the Geometry and Algebra II tests, schools using both the traditional and the alternate day (A/B) block schedule had significantly higher ($p<.05$) pass rates than those using the 4X4 semester block model.

On the Earth Science test, schools operating under the traditional scheduling model reported significantly higher pass rates ($p<.05$) than those using the 4X4 semester block model.

On the Biology test, schools using both the alternate day (A/B) block schedule and traditional models had significantly higher pass rates ($p<.05$) than those operating under the 4X4 block scheduling model.

On the final science test, Chemistry, schools using the traditional scheduling model earned significantly higher ($p<.05$) pass rates than schools operating under either the alternate day (A/B) block schedule or 4X4 semester block schedule.

On each of the social studies tests, U. S. History, World History A, and World History B tests, schools using both the alternate day (A/B) block schedule and traditional had significantly higher pass rates ($p<.05$) than those operating under the 4X4 block scheduling model.

Research Question 2: Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method and/or the traditional six- or seven-class period day scheduling models?

Analysis of the data gathered for this study indicates that there was a significant difference ($p<.05$) in the mean scaled scores based upon the type of schedule used on

nearly every measure tested. In the case of all tests with the exception of the Algebra I test (for which scheduling model did not impact test scores) and the Chemistry test (for which schools using traditional schedules scored significantly higher than did those using either block scheduling method), schools using the 4X4 semester block scheduling model scored significantly lower than did those using either the alternating day (A/B) block schedule or the traditional scheduling model. This is summarized in Table 66, Summary of Findings, Main Effects of Scheduling Model on End-of-Course Standards of Learning Test Scores.

Table 66

Summary of Findings, Main Effects of Scheduling Model on End-of-Course Standards of Learning Test Scores

	Mean Scaled Score			
End-of Course SOL Test Measure	A/B Block Schedule	4X4 Block Schedule	Traditional Schedule	Significant Difference ($p<.05$)?
Algebra I	393.9	393.5	398.2	Not significant
Geometry	415.7	400.2	415.3	4X4 significantly lower than A/B & traditional models
Algebra II	401.6	386.7	403.2	4X4 significantly lower than A/B & traditional models
Earth Science	421.2	415.0	422.0	4X4 significantly lower than A/B & traditional models
Biology	435.4	423.8	433.9	4X4 significantly lower than A/B & traditional models
Chemistry	413.8	408.2	421.5	Both 4X4 & A/B significantly lower than traditional model
U.S. History	379.5	367.1	376.6	4X4 significantly lower than A/B & traditional models
World History A	424.2	405.5	418.8	4X4 significantly lower than A/B & traditional models
World History B	407.3	390.8	403.6	4X4 significantly lower than A/B & traditional models

On both the Geometry and Algebra II tests, schools using both the alternate day (A/B) block schedule and the traditional schedule had significantly higher ($p<.05$) scores than those using the 4X4 semester block model.

On both the Earth Science and Biology tests, schools operating under both the traditional scheduling model and the alternate day (A/B) block schedule reported significantly higher scores ($p<.05$) than those using the 4X4 semester block model.

Research Question 3: Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?

Analysis of the data gathered for this study indicates that there was a significant interaction ($p<.05$) of the scheduling model used by a school and the type of school community in the mean pass rates of the study groups on several of the dependent measures. This is summarized in Table 67, Summary of Findings, Interaction of Scheduling Model*School Community on End-of-Course Standards of Learning Pass Rates.

Although there were no sigificant differences in the main effect for either scheduling model or school community on the pass rates on Algebra I Standards of Learning end-of-course test, there was a significant interaction ($p<.05$) between the two variables. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did schools in any of the following subgroups: 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*, Traditional*Urban, and Traditional*Suburban.

The was a significant interaction ($p<.05$) between scheduling model and school community on pass rates for the Geometry Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study.

Table 67

Summary of Findings, Interaction of Scheduling Model*School Community on End-of-Course Standards of Learning Pass Rates

End-of-Course SOL Test	Mean Pass Rate (%)									
	Alternating Day (A/B) Block			4X4 Semester Block			Traditional 6- or 7-Class Period Day			
	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Significant Interaction ($p<.05$) ?
Algebra I	32.3	42.1	35.4	9.6	38.4	40.3	43.6	44.9	40.1	4X4*Urban schools significantly lower than 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*Suburban, Traditonal* Urban, Traditional*Suburban
Geometry	50.3	64.9	49.9	16.8	50.0	47.4	58.3	64.1	56.8	4X4*Urban schools significantly lower than all other subgroups
Algebra II	47.0	53.9	31.5	23.3	39.9	36.2	50.8	54.4	42.8	No significant interactions
Earth Science	53.0	69.7	60.6	35.8	63.6	59.8	58.7	73.0	65.0	No significant interactions
Biology	74.4	85.0	76.4	58.0	76.0	73.1	79.6	85.9	76.1	4X4*Urban schools significantly lower than all other subgroups
Chemistry	62.9	65.3	54.4	41.2	64.4	59.1	66.4	75.4	69.4	No significant interactions
U.S. History	23.4	37.9	25.4	16.5	26.8	23.3	28.1	36.5	24.7	No significant interactions
World History A	73.4	73.6	57.1	26.4	58.9	52.9	68.1	77.3	57.3	4X4*Urban schools significantly lower than all other subgroups; 4X4*Rural schools significantly lower than Traditional*Suburban
World History B	35.7	59.5	26.1	13.7	43.6	36.4	38.7	57.5	41.0	4X4*Urban schools significantly lower than 4X4*Suburban, Traditional*Suburban, A/B* Suburban; A/B*Rural schools significantly lower than Traditional* Suburban, A/B*Suburban

There was no significant interaction ($p<.05$) between scheduling model used and school community in the pass rates for the Algebra II Standards of Learning end-of-course test. This was also the case with the Earth Science Standards of Learning end-of-course test.

There was a significant interaction ($p<.05$) noted between scheduling model and school community in the pass rate on the Biology Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study.

There was no significant interaction ($p<.05$) between scheduling model used and school community in the pass rates for the Chemistry Standards of Learning end-of-course test. This was also the case for the U. S. History Standards of Learning end-of-course test.

There was a significant interaction ($p<.05$) between scheduling model and school community in the pass rate on the World History A Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study. Additionally, schools in rural communities using the 4X4 semester block schedule scored significantly lower ($p<.05$) than did schools in suburban communities using traditional scheduling models.

There was also a significant interaction ($p<.05$) between scheduling model and school community in the pass rate on the World History B Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did those in the following subgroups: 4X4*Suburban, Traditional*Suburban, and A/B*Suburban. Additionally, schools in rural communities

operating under the alternating day (A/B) scheduling model scored significantly lower ($p<.05$) than did those in suburban communities using either traditional or alternate day (A/B) block scheduling models.

Research Question 4: Is there a difference in scores of students taking Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of schedule used and urbanicity of the school?

Analysis of the data gathered for this study indicates that there was a significant interaction ($p<.05$) between the scheduling model used by a school and the type of school community in the mean pass rates of the study groups on several of the dependent variables. This is summarized in Table 68, Summary of Findings, Interaction of Scheduling Model*School Community on End-of-Course Standards of Learning Scaled Scores.

There was a significant interaction ($p<.05$) between scheduling model used and the type of school community on the mean scaled test scores on the Algebra I Standards of Learning end-of-course tests. Schools in urban communities operating under the 4X4 semester block scheduling model scored significantly lower ($p<.05$) than did the following subgroups: 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*Suburban, Traditional*Urban, and Traditional*Suburban.

The was a significant interaction ($p<.05$) between scheduling model and school community on mean scaled scores for the Geometry Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study.

Table 68

Summary of Findings, Interaction of Scheduling Model*School Community on End-of-Course Standards of Learning Scaled Scores

End-of-Course SOL Test	Mean Scaled Scores									Significant Interaction (p<.05) ?
	Alternating Day (A/B) Block			4X4 Semester Block			Traditional 6- or 7-Class Period Day			
	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	
Algebra I	387.9	397.2	390.6	364.7	394.0	395.9	399.2	400.4	394.4	4X4*Urban schools significantly lower than 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*Suburban, Traditonal* Urban, Traditional*Suburban
Geometry	404.6	423.2	404.7	372.1	404.9	400.8	414.5	419.7	411.7	4X4*Urban schools significantly lower than all other subgroups
Algebra II	398.2	409.4	380.3	363.3	390.0	387.6	403.7	410.2	395.9	4X4*Urban schools significantly lower than A/B*Suburban Traditional*Suburban
Earth Science	407.9	428.0	415.6	387.2	421.1	414.7	414.2	431.2	419.8	No significant interactions
Biology	427.4	440.5	428.4	405.0	426.6	424.1	433.1	442.0	426.8	4X4*Urban schools significantly lower than all other subgroups except 4X4*Rural
Chemistry	415.o	416.2	404.7	388.0	412.9	408.2	420.3	426.1	418.1	No significant interactions
U.S. History	367.5	387.3	368.5	353.0	371.8	366.3	373.6	385.3	370.5	No significant interactions
World History A	425.8	427.1	408.8	379.9	409.7	405.4	422.6	430.5	407.6	4X4*Urban schools significantly lower than all other subgroups; 4X4*Rural schools significantly lower than Traditional*Suburban
World History B	392.2	419.1	379.8	368.1	395.7	390.7	394.4	415.5	394.9	4X4*Urban & A/B*Rural schools significantly lower than Traditional*Suburban, A/B* Suburban

There was also a significant interaction ($p<.05$) between scheduling model used and school community in the scaled scores for the Algebra II Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did those in suburban communities using either the alternate day (A/B) block schedule or traditional scheduling.

This was no significant interaction ($p<.05$) between scheduling model and school community on the scaled scores for the Earth Science Standards of Learning end-of-course test.

There was a significant interaction ($p<.05$) between scheduling model and school community in the mean scaled scores on the Biology Standards of Learning end-of-course test. Schools in urban communities using the 4X4 semester block scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study with the exception of schools in rural communities using the 4X4 semester block scheduling model.

There was no significant interaction ($p<.05$) between scheduling model used and school community in the mean scaled scores for the Chemistry Standards of Learning end-of-course test. This was also the case for the U. S. History Standards of Learning end-of-course test.

There was a significant interaction ($p<.05$) between scheduling model and school community in the scaled scores on the World History A Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model scored significantly lower ($p<.05$) than did all other subgroups in the study. Additionally, schools in rural communities using the 4X4 semester block schedule scored significantly

lower ($p<.05$) than did schools in suburban communities using traditional scheduling models.

Finally, there was also a significant interaction ($p<.05$) between scheduling model and school community in the mean scaled scores on the World History B Standards of Learning end-of-course test. Schools in urban communities using the 4X4 scheduling model or rural communities using the alternate day (A/B) block schedule scored significantly lower ($p<.05$) than did those in suburban schools operating under either the traditional scheduling model or alternate day (A/B) block schedule.

CHAPTER 5

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

This chapter includes a summary of the research findings as well as a discussion of how these findings compare and contrast with other research on the impact of block scheduling on student acheivement as measured by objective testing. The chapter also addresses implications for scheduling practices in secondary education. The chapter concludes with recommendations for further research.

The reader is advised to bear in mind the limitations of the study when considering the findings, conclusions, implications, and recommendations made by the researcher. The first set of limitations was identified prior to beginning the research.

1. The study did not control for variants in the scheduling models used by the schools included.
2. The study did not control for the processes used by each school when adopting and implementing scheduling models.
3. The study did not control for the teaching practices and strategies used by teachers in any of the included scheduling models.
4. The study did not control for the amount, content, or quality of staff development and other training used to prepare teacher to implement the scheduling model chosen by the schools.
5. The schools in the study were designated as either urban, suburban, or rural based upon differing criteria (i.e., the urbanicity of some schools was identified by the Virginia State Department of Education, while the urbanicity of others was

determined by the researcher using information obtained about other schools in the division and data from the 1990 U.S. Census).

6. No attempt was made to control for initial differences in the abilities, socio-economic status, family background, etc., of the students attending the schools included in this study.

7. The schools included in the study are all public schools within the boundaries of the Commonwealth of Virginia; this may limit the generalizability of the results.

After collecting the data, the researcher identified the following additional limitations to the study:

1. Two of the research questions that were designed to explore whether the number of years that a school has used a given scheduling model impact pass rates or test scores originally intended for inclusion in the study were dropped. This was done because data specifying how long schools have used traditional scheduling models were unavailable.

2. Two of the nine subgroups used to address the interaction of scheduling model and school community (Research Questions 3 and 4) contain fewer than 20 schools (there are only 6 urban schools using the 4X4 semester block scheduling model, and 19 rural schools that have adopted the alternating day (A/B) block scheduling model). This may compromise the accuracy of the statistical analysis for interaction effects.

3. The study did not control for differences that may have resulted due to the fact that the schools included in the study house different grade levels.

4. The study was conducted using pass rates and scores produced by students prior to the year that students must pass the tests to graduate. Students therefore, may not have taken the tests seriously.

Summary of Findings

Research Question 1: Is there a difference in the percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared with those in schools using the alternate day (A/B) block scheduling method, and/or the traditional six- or seven-class period day scheduling models?

The study revealed that schools operating under the 4X4 semester block scheduling model passed at rates significantly lower ($p<.05$) than schools using either the alternate day (A/B) block schedule or traditional scheduling models on the end-of-course SOL tests in the following subjects: Geometry, Algebra II, Biology, Chemistry, U. S. History, World History A, and World History B. The study also revealed that schools using the traditional scheduling model had significantly higher pass rates ($p<.05$) than schools using either the 4X4 semester block or alternate day (A/B) block schedules in Earth Science. Finally, there was no significant difference ($p<.05$) in the pass rate for the Algebra I test based on the schedule that was used for instruction.

Research Question 2: Is there a difference in the scores of students taking Virginia's high school level end-of-course Standards of Learning assessments in schools using the 4X4 semester block scheduling method compared to those in schools using the alternate day (A/B) block scheduling method and/or the traditional six- or seven-class period day scheduling models?

The study revealed that schools operating under the 4X4 semester block scheduling model produced mean scaled scores significantly lower ($p<.05$) than schools using either the alternate day (A/B) block schedule or traditional scheduling models on the end-of-course SOL tests in the following subjects: Geometry, Algebra II, Biology, Chemistry, U. S. History, World History A, and World History B. The study also revealed that schools using the traditional scheduling model had significantly higher mean scaled scores ($p<.05$) than schools using either the 4X4 semester block or alternate day (A/B) block schedules in Earth Science. Finally, there was no significant difference ($p<.05$) in the mean scaled scores for the Algebra I test based on the schedule that was used for instruction.

Research Question 3: Is there a difference in percentage of students who pass Virginia's high school level, end-of-course Standards of Learning assessments based upon an interaction of type of scheduled used and urbanicity of the school?

The study revealed that schools operating under the 4X4 semester block scheduling model that are located in urban communities demonstrated significantly lower ($p<.05$) pass rates than all other subgroups on tests in the following subjects: Geometry, Biology, and World History A. The study further revealed that schools using the 4X4 semester block scheduling model located in rural communities passed the World History

A test at rates significantly lower ($p<.05$) than schools in urban areas operating under the traditional schedule.

Schools operating under the 4X4 semester block scheduling model that are located in urban communities passed at significantly lower ($p<.05$) rates on the Algebra I test than schools in the following subgroups: 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*Suburban, Traditional*Urban, and Traditional*Suburban.

Further, schools operating under the 4X4 semester block scheduling model located in urban areas also passed at rates significantly lower ($p<.05$) than those in suburban areas, regardless of whether the suburban schools operated under the alternate day (A/B) block, 4X4 semester block, or traditional scheduling models when they took the World History B test. The study also revealed that schools utilizing the alternate day (A/B) scheduling model located in rural communities produced pass rates significantly lower ($p<.05$) than schools operating under traditional scheduling models located in urban areas.

The study did not find any significant interactions between scheduling model and school community in the pass rates on the end-of-course SOL assessments in the following subjects: Algebra II, Earth Science, Chemistry, and U. S. History.

Research Question 4: Is there a difference in the scores of students taking Virginia's high school level, end-of-course Standards of Learning assessements based upon an interaction of tyhpe of schedule used and urbanicity of the school?

The study revealed that schools operating under the 4X4-semester block scheduling model that are located in urban communities demonstrated significantly lower ($p<.05$) mean scaled scores than all other subgroups on both the Geometry and World

History A tests. Further, schools using the 4X4 semester block scheduling model located in rural communities produced significantly lower ($p<.05$) mean scaled scores on the World History A test than schools in urban areas operating under the traditional schedule. On the end-of-course SOL Biology course, schools operating under the 4X4 semester block scheduling model and located in urban communities earned significantly lower ($p<.05$) scores than all other subgroups with the exception of schools using 4X4 semester block scheduling located in rural communities.

The study also revealed that schools operating under the 4X4 semester block scheduling model that are located in urban communities earned significantly lower ($p<.05$) scaled scores on the Algebra I test than schools in the following subgroups: 4X4*Suburban, Traditional*Rural, 4X4*Rural, A/B*Suburban, Traditional*Urban, and Traditional*Suburban. Further, schools using the 4X4 semester block schedule that are located in urban areas also scored significantly lower ($p<.05$) on the Algebra II test than schools in suburban areas using either the alternate day (A/B) block schedule or traditional scheduling methods.

When the World History B test was given, schools operating under the 4X4 semester block model located in urban areas, and those using the alternate day (A/B) block model that are located in rural areas both scored significantly lower ($p<.05$) than suburban schools operating under either the traditional or alternate day (A/B) block schedules.

The study did not find any significant interactions between scheduling model and school community on mean scaled scores for the end-of-course SOL assessments in the following subjects: Earth Science, Chemistry, and U. S. History.

Discussion of Findings

Context for the Study

Much of the available literature on alternative scheduling suggests that block scheduling models have positive impacts in at least three important ways. The first of these is school climate, where anecdotal reports and a small body of research suggest that school climate is enhanced in schools using block models because:

1. students and teachers report increased satisfaction under block scheduling models than in traditionally structured schools (Alam & Sieck, 1994; Carroll, 1994b; Ever thought . . ., 1994; Guskey & Kifer, 1995; Pierson, 1994; Ryan, 1991; Snyder, 1997);
2. deeper and more meaningful relationships are forged between students and both their teachers and their peers under block scheduling models than in traditionally scheduled schools (Andersen, 1982; Dow & George, 1998); and,
3. student involvement in extracurricular activities is reportedly increased under the 4X4-semester block model (Pierson, 1994).

This study was not designed to address these assertions.

A second area where improvements are claimed for schools that elect to operate under block scheduling models is improved instruction. Here, a body of largely anecdotal reports suggests that instruction is improved for several reasons when a block scheduling model is adopted. These include:

1. longer class periods allow for more efficient use of available instructional time (Canady & Rettig, 1996; Rettig & Canady, 1996); and

2. longer class and planning periods lend themselves to a greater variety of teaching techniques, thus encouraging teachers to increase their repertoires (Aguilera, 1996; Andersen, 1982; Canady & Rettig, 1996; Carroll, 1990; Dow & George, 1998; Edwards, 1993; Eineder & Bishop, 1997; Ever thought . . ., 1994; Fitzgerald, 1996; Frost, 1993; Gerking, 1995; Guskey & Kifer, 1995; Huff, 1995; Pierson, 1994; Rettig & Canady, 1996; Wilson, 1995).

Again, this study did not address these issues.

The third, and arguably most important, area that the literature suggests block scheduling impacts is student achievement. One of the most common claims of both anecdotal and research-based literature is the claim that students' grades improve when they are enrolled in schools/programs using block scheduling (Alam & Sieck, 1994; Andersen, 1982; Dow & George, 1998; Eineder & Bishop, 1997; Huff, 1995; Reid et al., 1994; Ryan, 1991; Snyder, 1997). According to the literature, these gains appear to be slightly higher in schools that have adopted the 4X4 semester block scheduling plan than in those utilizing the alternate day (A/B) block model. Another common claim in the literature is that depth and mastery of content are increased when using block scheduling models (Aguilera, 1996; Averett, 1994; Canady & Rettig, 1996; Carroll, 1990, 1994b; Edwards, 1993; Fitzgerald, 1996; Frost, 1993; Gerking, 1995; Guskey & Kifer, 1995; Huff, 1995; Pierson, 1994; Schoenstein, 1994; Snyder, 1996; Wilson, 1995). One must take these claims cautiously, however, because both student grades and mastery in these studies were based largely upon evaluations conducted by teachers, which may not always measure achievement objectively, and which certainly do not provide adequate data for comparison across classes, schools, or types of scheduling programs utilized.

A somewhat smaller body of literature has begun to address the problem of making comparisons between the relative impacts of the various scheduling models by measuring student achievement in terms of standardized and/or objective testing. The present study was designed to add to this growing body of knowledge. This body of knowledge will be discussed in comparison with this study later in this chapter.

Conclusions from the Study

Effects of Scheduling Upon Student Performance

When the main effects of scheduling models were compared on 18 measures, the results were remarkably consistent. Thirteen of the test measures yielded the same results: schools operating on the 4X4 semester block scheduling models consistently underperformed ($p<.05$) those using either the alternate day (A/B) block schedule or the traditional six- or seven-class period day schedule on both standard scores and percentage of students passing. In two of the measures that did not fit this pattern (percentage of students passing and mean standard score on the Chemistry test), both block scheduling models underperformed schools using the traditional model. In a third measure (percentage of students passing the Earth Science test), schools on the 4X4 semester block schedule significantly underperformed those using traditional schedules; no significant differences were noted between the alternate day (A/B) block schedule and either the 4X4 semester block or traditional scheduling models. In the final two measures that did not fit this pattern (percentage of students passing and mean standard scores on the Algebra I test), no significant differences were noted.

Likewise, when the data were analyzed to determine interaction effects between scheduling model and school community, similar results were found. In each of the 11

measures for which there was a significant interaction ($p<.05$), 4X4 semester block schools located in urban areas produced lower pass rates and mean standard scores than did schools in other subgroups. On three of these measures (percentage of students passing and mean scaled scores on the Geometry and the Biology test), schools in urban areas using the 4X4 semester block scheduling model significantly underperformed all other groups.

When compared to earlier studies addressing the impact of block scheduling on standardized test measures, these findings may be viewed on the surface as somewhat unexpected. On nationally normed tests that are not administered to measure achievement in a particular course, studies assert that scores are often higher at schools using block scheduling in general than at traditionally scheduled schools, and higher among students enrolled under the 4X4 semester block format than for those in schools utilizing the alternate day (A/B) block schedule. On the Scholastic Aptitude Test (SAT), for instance, small but insignificant gains have been noted for students enrolled at schools using both 4X4 semester block and alternate day (A/B) block scheduling (Pisapia & Westfall, 1997; Snyder, 1997; Wilson, 1995). Snyder (1997) also found significant increases on ACT tests among students enrolled under the 4X4 semester block model. Similarly, Pisapia and Westfall (1997) found higher Test of Academic Proficiency (TAP) scores among students enrolled in the 4X4 semester block programs than in alternate day (A/B) schools. Although this study addressed end-of-course tests, the results appear to contradict the findings of this literature.

When compared to other studies addressing end-of-course testing, the findings of this study appear to be similarly inconsistent with the findings of several authors. In

studies evaluating the impact of block scheduling models on A. P. tests, four authors (Aguilera, 1996; Dow & George, 1998; Guskey & Kifer, 1995; Snyder, 1997) claimed that more students took the tests when enrolled in schools using the 4X4 semester block schedule and that greater percentages of those students received passing scores of "3" or above than in traditionally scheduled schools. In a study of nine high schools in the Commonwealth of Virginia, however, Pisapia and Westfall (1997) reported opposite results; fewer students took A.P. courses and tests, and fewer of those students achieved passing grades. It should be noted here that comparisons between the results of Virginia's end-of-course Standards of Learning assessments and those achieved on A.P. tests should be done with extreme caution. All students in the Commonwealth of Virginia take most of the SOL tests, but it is generally only the brightest students who will take the A.P. tests.

In studies addressing the impact of scheduling models on end-of-course tests designed to be taken by all students, the results are similarly mixed. For example, Reid et al. (1994) reported that, while scores on standardized end-of-course tests generally increased among students in their study, scores declined (and failure rates subsequently increased) in math, biology, physics, and communications courses. In a 1994 study conducted in North Carolina, Averett (1994) reported that block schedules had little impact on end-of-course scores. In a follow-up study of testing data through 1996, the North Carolina Department of Education confirmed these results, adding that, when controlling for parents' level of education and the prior performance of schools on the test, blocked schools did show gains over traditionally scheduled schools. A study conducted in Maryland also found no significant differences on end-of-course

standardized tests at the same school before and after the adoption of the 4X4-semester block schedule (Guskey & Kifer, 1997). More recently, Wallinger (1998) found that there was no significant difference among student scores and achievement in French I based upon scheduling model used. However, Eineder and Bishop (1997) reported that two Canadian studies found that block scheduling had a negative impact upon standardized test scores, but noted that there was a significant time lag between the end of the course and the test date for students enrolled in blocked courses.

In this study, schools using the alternate day (A/B) block tended not to achieve signifcantly differently than schools using traditional models. This appears to be consistent with the findings of Averett (1994), as well as Guskey and Kifer (1997), but contradicts those of Eineder and Bishop (1997). The comparisons are reversed, however, when one considers the findings in this study indicating that schools operating under the 4X4 semester block model tend to underperform their peers in both alternate day (A/B) block models and traditional schedules.

There are several reasons why it may not be surprising to note that the findings of this study are not consistent with the body of knowledge on block scheduling. Perhaps the most important is that few research studies have been published on the impact of block scheduling on student performance as measured by standardized testing. As noted at several points in this report, most of the literature reflects anecdotal reports of successes achieved with particular programs. It is possible that there have been as many or more instances of less successful results attained at schools that chose not to publish their results.

Questions Raised by the Data

In considering the data in both raw form and after analysis, the researcher was struck by several questions that cannot be conclusively answered within the confines of this study. Some of these questions are considered below.

1. Why did schools using the 4X4 semester block schedule consistently underperform schools using both the alternate day (A/B) block schedule and traditional six- or seven-class period schedules on Virginia's high school level, end-of-course Standards of Learning assessments?

As with any study, the first hypothesis that must be considered to explain the consistent underperformance of schools using the 4X4 semester block scheduling model relative to those using either alternate day (A/B) block or traditional schedules is the null. It is possible that 4X4 semester block scheduling is inherently less effective in preparing students for Virginia's high school level, end-of-course Standards of Learning Assessments. However, several other possible hypotheses seem more promising to the researcher. These are discussed below.

Perhaps the most interesting rival hypothesis for the underperformance of schools using the 4X4 semester block schedule may be that the relatively low pass rates and scores by these schools is a result not of the scheduling model used by the school, but of the testing schedule. The Standards of Learning Assessments are given statewide using a schedule set by the Virginia State Department of Education. During the 1998-1999 school year, schools utilizing the 4X4 semester block scheduling model administered these tests during the period from December 12, 1998 through January 8, 1999 (for courses meeting during the first semester), and between May 10 and 25, 1999 (for

courses meeting during the second semester). Assuming an 18-week semester, students took the tests approximately 75-85% of the way through the course if they attended schools using 4X4 semester block scheduling. Schools using either the alternate day (A/B) block or traditional six- or seven-class period day scheduling administered the assessments between May 10 and 25, 1999. Consequently, students attending these schools took the tests after completing approximately 89-92% of the course. If teachers are able to cover approximately the same amount of material regardless of the scheduling model used (perhaps this is a dangerous assumption), students enrolled in schools using the 4X4 semester block scheduling model will have been exposed to anywhere from 4–17% less material than their peers in schools using other scheduling models. It stands to reason, then, that the performance on end-of-course tests for students who have been exposed to a smaller percentage of the curriculum on which a test is based would be at a disadvantage when their performance is compared with those who have been exposed to a greater percentage of the same curriculum.

When noting that the lowest scoring subgroup on every measure of the study was schools on the 4X4 semester block schedule located in urban areas, the researcher considered the following alternative hypothesis: the differences in performance by 4X4 semester block scheduled schools as a group were a direct result of the relatively lower performance of the students at these six urban schools. To test this hypothesis, the researcher removed these schools from the study and performed an additional analysis of variance where scheduling model served as the independent variable; pass rates and mean scaled scores on each of the tests were the dependent variables. It should be noted that urban schools were <u>not</u> removed from the alternate day (A/B) block and traditional

samples. In every case except those using the Earth Science test, the results were unchanged; schools using the 4X4 semester block schedule significantly ($p<.05$) underperformed schools using both alternate day (A/B) block schedules and traditional schedules on both pass rates and scaled scores on each of the following tests: Geometry, Algebra II, Biology, U. S. History, World History A, and World History B. Additionally, schools utilizing the traditional six- or seven-class period schedule significantly ($p<.05$) outperformed schools using either of the block scheduling models on both pass rates and scaled scores on the Chemistry test. Finally, no significant main effects were reported for pass rates or scaled scores on either the Algebra I or the Earth Science tests. Because the results changed so little from the analysis performed with these six schools included, it is probably safe to reject the hypothesis that the underperformance of by schools using 4X4 semester block scheduling relative to those using other models is based only upon the lower percentages of students passing and lower student scores among urban schools in this group.

Another possible reason for the apparently consistent underperformance of schools on the 4X4 semester block scheduling method when measured by the SOL tests is the possibility that several of the apparently significant main effects were actually examples of Type I error, and that the differences are, in fact, not significant. If this is the case, it may be an artifact of the choice made by the researcher to abandon convention and report main effects even when an interaction effect has been identified. Kiess (1996) pointed out that "if a statistically significant interaction occurs in a factorial design, then main effects for either factor *A* or factor *B* may be artifactual and may not present meaningful results about the effect of that independent variable" (p. 318). In this study,

significant main effects were reported for nine of 18 test measures in which significant interactions were also reported (percentage of students passing Geometry, Biology, World History A, and World History B, and mean scaled scores for tests in Geometry, Algebra II, Biology, World History A, and World History B). If the main effects for these nine tests were removed, and adding the fact that there were not significant main effects reported for either the percentage of students passing or mean scaled scores for the Algebra I test, only seven main effects remain from 18 measures. The smaller number of test measures for which significant main effects indicating that schools usin the 4X4 semester block scheduling model underperform schools using other scheduling models may lessen the practical (if not statistical) significance of these results.

2. Why did schools in urban settings operating under the 4X4-semester block scheduling model consistently underperform other schools on Virginia's high school level, end-of-course Standards of Learning assessments?

As pointed out in the discussion of findings, schools in urban settings that utilized the 4X4 semester block scheduling model during the 1998-1999 school year significantly ($p<.05$) underperformed schools on one or more of the other subgroups in fully two-thirds of the measures used on this study. Furthermore, the six schools in this subgroup produced lower mean pass rates and lower mean scaled scores than all other subgroups on each of the 18 test measures.

One possible hypothesis for this finding is the null: urban schools using the 4X4 semester block scheduling model achieve poorly on standardized tests. The reader is cautioned against accepting this hypothesis based upon the findings of this study, however, for several reasons. The first is the very small sample size. The six urban

schools represent only 10.9% of the urban schools in the Commonwealth of Virginia, and 2.1% of the high schools included in the study. It is conceivable that, if more of the urban schools in the Commonwealth were to adopt the 4X4 semester block schedule, the average percentage of students passing, and average scaled scores, would more closely resemble those for the rest of the population. Another reason to use caution when considering this hypothesis is the fact that little is known about other factors that may impact student performance at these schools, including socioeconomic status, the amount and quality of staff development available for teachers, and the educational attainment level of the students' families, to list but a few.

An alternative hypothesis that might explain the relatively poor performance of this group of schools is that the schools themselves are in some important ways different from the rest of the schools in the sample. The Virginia State Department of Education has identified 15 "central cities" across the Commonwealth. The six schools in this study that have adopted the 4X4 semester block scheduling model represent only two of these central cities. Furthermore, each of the high schools in one of these central cities is using the 4X4 semester block scheduling model. This suggests that there may be deeper problems at work to suppress student performance on the end-of-course Standards of Learning assessments than choice of scheduling model. It is beyond the scope of this study to address this hypothesis.

3. Why were there no main effects for scheduling model obtained for either the percentage of students passing or for mean scaled scores on the end-of-course Standards of Learning assessment in Algebra I?

The first answer to be considered when attempting to answer this question would be the null hypothesis – that scheduling model is unimportant when learning Algebra I. This answer appears to be somewhat simplistic, however, when one considers the facts that: (a) there was a significant ($p<.05$) interaction effect indicating that 4X4 semester blocked schools in urban areas underperformed students attending schools fitting into five of the other subgroups, and (b) each of the other test measures did display a significant ($p<.05$) main effect for scheduling model.

An alternative hypothesis that may have some merit is that the group of students who take the Algebra I test while in high school differs from those students who take the other end-of-course Standards of Learning assessments. In most cases, students taking the SOL tests represent a heterogeneous group representative of the entire student body in the Commonwealth of Virginia. Every student in the Commonwealth (regardless of academic ability and performance) is required to take most of the SOL assessments while in high school. The strongest mathmatics students, however, often take Algebra I while still in middle or junior high school. It may reasonably be expected, therefore, that the group of primarily average and weaker math students taking the Algebra I test in high school would not perform as well, on average, as they would if the scores of the strongest math students in the school were considered when calculating the precentage of students passing and mean scores. The fact that the Algebra I group may have been more homogeneous, thus having a lower standard deviation, may have effected the ANOVA.

Implications for Educational Decision Makers

Implications for School or School Division Leaders, Nationwide

1. Perhaps the most striking finding of this study is the consistent underperformance on the end-of-course Standards of Learning assessments by schools that have adopted the 4X4 semester block schedule. The first recommendation for policy-makers arising from this study stems from the hypothesis suggesting that the dates chosen for administering the end-of-course Standards of Learning assessments may have an impact on the relatively lower performance of schools operating under the 4X4 semester block scheduling models. The researcher would urge those in a position to set scheduling windows for end-of-course testing to set dates as late in the semester or school year as possible, so that students may receive as much instruction as possible prior to taking the test. This could be expected to decrease the likelihood that incorrectly answered test questions reflect items not taught, rather than items not mastered.

2. While lower scores and pass rates on end-of-course tests certainly impact schools, it is important to consider their effects on students. If one accepts the hypothesis that the reason students enrolled in schools using the 4X4 semester block schedule consistently underperform their peers in schools using other scheduling models is that they are learning less because of the scheduling model used, the implications for these students could be severe. Students who do not learn as much as their peers while in high school may be at a disadvantage in postsecondary education, and may not be expected to achieve the same degree of financial and/or social success as their peers who learned more while in high school. Even if the reader accepts one or more of the alternative hypotheses, and assumes that the relative underperformance of those students enrolled in schools using

the 4X4 semester block scheduling reflects some factor other than the learning or ability of the student, the implications for the students can be the same, especially in states like Virginia, where student performance on these tests will directly impact their ability to earn a high school diploma.

3. An additional important finding is the consistently lower percentage of students passing, and lower scores on all test measures of urban schools that have adopted the 4X4 semester block scheduling model compared to the other subgroups included in the study. While it is true that the low pass rates and scores reported for urban schools using the 4X4 semester block scheduling model represent only six of the nearly 300 schools included in the study, and only two of the Commonwealth of Virginia's 15 central cities, the results are consistent enough to give serious pause to decision makers in urban settings when considering the use of the 4X4 semester block scheduling model at the high school level. Rather than urging urban schools currently using this scheduling model, or advising those considering adopting the 4X4 semester block scheduling model, to avoid its use, the researcher recommends that further studies be conducted to address the causes of low performance at these schools.

4. Another seemingly obvious conclusion that might be drawn from this study is that, compared to both the alternate day (A/B) block schedule and traditional six- or seven-class period day, schools using the 4X4 semester block schedule tend to achieve lower pass rates and scores on Virginia's end-of-course Standards of Learning assessments. While Virginia's public high schools using this model during the 1998-1999 school year did not perform as well on most of these test measures as did schools using other scheduling models, the reader is reminded that main effects for scheduling model

were reported in a nonconventional fashion. Because main effects were reported even when there were significant interactions, the significant main effects reported for pass rates on four of the tests may represent false positives, as might the significant main effects reported for five of the measures of test scores. If the data were reported using the standard protocol, significant main effects for scheduling models noted on 16 of the test measures would have been reduced to seven, representing significant main effects for 38.8% of the test measures, rather than 88.9%. While this reduction in the number of significant findings is notable, significant main effects remain for nearly on third of the 18 test measures used. If students at schools using the 4X4 semester block schedule can be expected to perform poorly (relative to their peers at schools using other scheduling models) on nearly one third of the tests they are given, school leaders should be concerned about the impact of adopting 4X4 block scheduling.

5. Although test scores and pass rates are an important measure of achievement, the researcher cautions school leaders to not abandon or drop from consideration the 4X4 semester block scheduling model as an option for their schools based solely upon the findings of this study. Instead, the researcher urges school and school division leaders who are considering changing scheduling models to consider this study as only one factor in their decision-making process. The literature on block scheduling asserts that several important benefits may arise from the adoption of either the alternate day (A/B) block scheduling model, intensive or Copernican models, or the 4X4 semester block models. This study does not address any of these important possible benefits of adopting alternative scheduling models. The researcher would advise leaders in decision-making

positions to consider each of these possible benefits in light of the particular needs of their schools when making scheduling decisions.

Implications for School or School Division Leaders in Virginia

1. While the researcher would counsel school decision makers in most states and localities to consider this study as one of several factors when determining the scheduling model to be used by a school or school division, school leaders in Virginia are urged to consider the results much more carefully. In Virginia, the high school level end-of-course testing is used as a decisive factor in determining school accreditation status and students' eligibility to graduate. This study clearly suggests that high schools in Virginia using the 4X4 semester block scheduling model do not perform as well on these high-stakes tests as schools using other scheduling models.

2. As discussed above, schools utilizing the 4X4 semester block scheduling posted significantly ($p<.05$) lower percentages of students passing these tests than schools using either the alternate day (A/B) block schedule or traditional six- or seven-class period days on six of the nine test measures used, and significantly lower than schools using the tradition model on two of the other tests. Even if the main effects are not considered significant in cases where there was an interaction between scheduling model and school community, schools using the 4X4 semester block posted lower percentages of students passing these tests than schools using either the alternate day (A/B) block schedule or traditional six- or seven-class period days on three of the nine test measures used, and significantly lower than schools using the tradition model on one of the other tests.

When the measures used were mean scaled scores, rather than percentage of students passing the tests, the results were much the same. That is, schools utilizing the

4X4 semester block scheduling posted significantly ($p<.05$) lower mean standard scores on these tests than schools using either the alternate day (A/B) block schedule or traditional six- or seven-class period days on six of the nine test measures used, and significantly lower scores than schools using the traditional model on two of the other tests. Even when the main effects are not considered significant, in cases where there was an interaction determined between scheduling model and school community, schools using the 4X4 semester block posted lower mean scaled scores on these tests than schools using either the alternate day (A/B) block schedule or traditional six- or seven-class period days on two of the nine test measures, and significantly lower than schools using the traditional model on one of the other tests.

The researcher would, therefore, advise decision makers in Virginia to carefully monitor the performance of their schools on the subsequent Standards of Learning end-of-course tests. It may be that the test results used for this study are not typical and that subsequent years will show a different result. However, results from the 1999 testing program do not bode well for schools using the 4X4 semester block schedule.

3. The choice between alternate day (A/B) block scheduling and traditional six- or seven-class period day scheduling models, however, is less clear. While both of these models appear to yield both higher percentages of students passing and higher scaled scores than the 4X4 semester block scheduling model, there are few significant differences between alternate day (A/B) block scheduling and traditional six- or seven-class period day scheduling models.

When assessing the main effects of the scheduling model used on the percentage of students passing the end-of-course SOL tests, a significant ($p<.05$) difference between

schools using the alternate day (A/B) block scheduling model and those using the traditional six- or seven-class period day was noted only on the Chemistry test. This was also the case when assessing the main effects of scheduling model on the mean scaled scores of students taking this test. It should be noted in this case, however, that although the difference on mean scaled scores was statistically significant, less than eight points separated the mean scores; therefore, this may not represent a practical difference. Because traditionally scheduled schools perform better on the Chemistry test, then, the traditional six- or seven-class period day schedule would appear to be slightly preferable to the alternate day (A/B) block scheduling model in states such as Virginia, which use high-stakes end-of-course testing as important factors when determining school accreditation and/or eligibility for graduation.

Caveats

When considering the possible implications of this study for educational practice and policy-making, the reader is reminded of several caveats. The results represent an inquiry into possible differences in the academic performance of public high schools in Virginia based upon the scheduling model used; the research was not conceived, nor should it be read as using an experimental, or even a quasi-experimental design. The researcher did not control for initial differences. It is, therefore, possible that the results of this study represent initial differences between schools, rather than differences between scheduling models.

A second caveat also arises based upon the nature of the study. The researcher did not conduct a comprehensive evaluation study on the relative merits of the three scheduling methods identified as independent variables for the study. The study

addressed only the impact of scheduling model upon end-of-course testing. It did not consider other possible advantages and/or disadvantages that have been claimed to arise from the adoption of block scheduling models. While it may be reasonable to consider the results of this study when making decisions regarding the scheduling model to be used at a school, it should be looked at as providing only one piece of information to be considered.

Additional caveats arise from the nature of the measures chosen to assess student achievement in this study. In Chapter 2, the researcher pointed out that most of the previous literature on block scheduling models evaluated student performance based largely on either teacher-assigned grades or performance on standardized tests (such as the SAT and ACT), which are not intended to assess students based upon the objectives of the curriculum of a particular course. The opposite may be seen as a weakness of this study – it addresses student performance only in terms of one type of measure, norm-referenced end-of-course testing. It should, therefore, be read as a part of the body of literature on block scheduling, but not looked upon as definitive.

The reader is further reminded that the results of this study are based solely upon the performance of students on test measures that are only used in the Commonwealth of Virginia, and that were designed specifically to evaluate student performance on Virginia's curriculum. The reader, therefore, is advised to use caution when using this study to predict possible implications of scheduling model on other norm-referenced or end-of-course tests.

Recommendations for Further Research

1. It is possible that the schedule by which Virginia's end-of-course Standards of Learning assessments are given is a cause of the relatively low performance of schools using the 4X4 semester block scheduling model. For 4X4 schools, the assessments are administered relatively early in the course compared to those that have adopted alternate day (A/B) block and traditional scheduling models. Future research on the impact of block scheduling on norm-referenced end-of-course testing performance should control for the relative time in the course for which the test measure(s) are given.

2. The findings of this study are based upon the performance of students in Virginia on tests that are taken only in Virginia. The results, therefore, can only be generalized to schools outside the Commonwealth of Virginia using the greatest caution. Future research on the impact of block scheduling on student achievement on norm-referenced end-of-course testing should focus on a nationwide sampling of schools using one or more nationally normed tests.

3. This study does not address the likelihood that factors other than scheduling model and urbanicity have the potential to impact the mean performance of schools on Virginia's high school level, end-of-course Standards of Learning assessments. Future researchers should identify the schools that consistently scored most poorly, as well as those which consistently produced the highest scores and pass rates on these tests, and attempt to determine whether variables other than scheduling model and urbanicity might explain the differences between high and low performing schools.

4. The anecdotal literature on block scheduling suggests several reasons why schools adopting a block scheduling model might be expected to exhibit improvements in several

areas, including student performance. Future researchers on block scheduling or effective schools should identify a group of the highest and lowest performing schools using various types of scheduling models and perform either qualitative or mixed qualitative-quantitative studies to attempt to identify reasons why schools in each subgroup perform either well or poorly relative to other schools using similar scheduling models.

5. Little of the research on alternative schedules conducted to date addresses the assertions made in the anecdotal literature that adoption of block scheduling models enhances the quality and variety of instruction. Future research on block scheduling should focus on measuring the impact of scheduling model on observable instructional practices.

6. The findings of this research suggest that schools in urban areas using 4X4 semester block schedules may be expected to perform at lower levels than other schools either using different scheduling models or in suburban or rural communities. The very small size of the sample ($\underline{N}$=6), however, makes these findings suspect. Future research on the impact of block scheduling on student achievement on norm-referenced tests should address possible interaction effects of scheduling model and urbanicity based on a large enough sample size to draw firmer conclusions than were possible in this study.

7. The findings of this study are based upon the average performance of students in each of Virginia's high schools on norm-referenced tests. No attempt was made to control for types of students or schools beyond scheduling model and urbanicity. Future research on block scheduling should use pairwise sampling to compare the impact of block scheduling on the performance of students from similar backgrounds.

8. As illustrated in Figure 8, Description of Sample (see page 68), schools in suburban settings have adopted the alternate day (A/B) scheduling model in disproportionately high numbers. Similarly, a disproportionately high number of schools in rural settings, and a disproportionately low number of schools in urban settings, appear to have adopted the 4X4 semester block scheduling model. Little or no research has been published to date on the types of schools or school communities that adopt various scheduling models. Future research on block scheduling should attempt to determine if the types of schools that choose to (or not to) adopt given scheduling models differ from those that choose other models.

9. The researcher suggested that a possible explanation for the lack of main effects for scheduling model for the Algebra I end-of-course SOL test might have arisen because the strongest math students frequently take this test while in middle or junior high school, thus making the group of students taking the test at the high school level more homogeneous than those taking the other tests, thereby reducing the standard deviation. Most of the research on block scheduling has addressed the impact of the program on the entire school population, without disaggregating the data to enable researchers to address the impact of scheduling on students of varying levels of ability. Future research on block scheduling should address the impacts of block scheduling on the achievement of students of various ability levels and backgrounds.

Appendix

Virginia Standards of Learning Assessments: Passing Scores Established by the Board of Education

SOL Test	Pass (proficient)	Percentage	Pass (advanced)	Percentage
Algebra I	27 out of 50 items	54%	45 out of 50 items	90%
Geometry	27 out of 45 items	60%	41 out of 45 items	91%
Algebra II	31 out of 50 items	62%	45 out of 50 items	90%
Earth Science	30 out of 50 items	60%	45 out of 50 items	90%
Biology	26 out of 50 items	52%	45 out of 50 items	90%
Chemistry	27 out of 50 items	54%	45 out of 50 items	90%
U.S. History	40 out of 61 items	66%	55 out of 61 items	90%
World History A	33 out of 61 items	54%	55 out of 61 items	90%
World History B	36 out of 63 items	57%	57 out of 63 items	90%

(Adapted from Virginia Department of Education, 1998a)

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