

**Academic Performance Differences between
Students in Block and Traditionally Scheduled High Schools**

1993-2000

(A Brief Research Report)

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Introduction

Schooling is first and foremost about teaching and learning. The strategies and structures implemented in schools are intended to enhance teaching and learning. In recent years, educators and administrators, nationwide, have turned their inquiry toward the manner in which time is allotted to various subject areas during the school day, seeking to discover if there is a way to organize instruction more effectively and to improve the quality of teaching and learning. At the high school level, during the past decade the increase in numbers of schools implementing block scheduling has been dramatic. Semester block scheduling (4×4) typically offers four subjects per semester with a total of 135 hours as one credit for one subject, meets 5 times a week for 90 minutes per class, and lasts 90 days each semester. Based on Cawelti's (1994) national survey, nearly 40% of American high schools had implemented block scheduling in 1994. Rettig (1995) estimated that more than 50% of high schools nationwide were operating or considering the adoption of some form of block scheduling in 1995. In North Carolina, high school block scheduling grew rapidly – from 6 schools (1.6% of all high schools) in the 1992-93 school year to 288 schools (71.8%) in the 1999-2000 school year. Therefore, it is worthwhile to study the impact of block scheduling on teaching and learning.

A number of surveys reported generally favorable teacher and student attitudes and perceptions about block scheduling (North Carolina Department of Instruction 1998; Mutter, Chase & Nichols, 1997; Hurley 1997; Staunton 1997; Cooper 1996; Queen, Algozzine, & Eaddy, 1996; and Reid 1995). Several quantitative studies reported mixed results of student academic performance in comparing block and traditional schedules. Wronkovich, Hess, and Robinson (1997) indicated that traditional scheduling was preferable for the students in mathematics. Hess, Wronkovich, and Robinson (1998) stated that there were no significant differences in student achievement between block and traditional scheduling in geometry and history, but significant differences in biology and English with the block scheduled students receiving higher scores. Cobb, Abate, and Baker (1999) found that the block scheduled students performed significantly less well on mathematics standardized tests, but not differently on reading standardized tests and writing tests in comparison to the traditionally scheduled students. Veal and Schrieber's (2000) findings generally supported Cobb et al. (1999). However, studies comparing student academic performance between 4×4 block and traditionally scheduled grades 9-12 high schools using large-sample longitudinal data have not been found to date. The purpose of this research is to add to the literature base on 4×4 block scheduling by using the large state multi-year (1992-93 to 1999-2000 school years) test database to study the academic performance difference between students in 4×4 block and traditionally scheduled grades 9-12 high schools.

Procedures

This is an ex post facto study. In the educational settings, most research cannot be carried out experimentally by randomly selecting and assigning subjects and actively manipulating independent variables. It would be unlikely that experimental techniques could be used to determine the causes of variation for most educational problems. Yet we are still interested in question of causation. Hence, we use an ex post facto design and try to infer causation. Because we cannot manipulate and/or control exposure to the active experimental variable, we are forced to study subjects who have different exposures to the independent variable (i.e., scheduling status - block versus traditional).

Research Question

Are there performance differences on state End-of-Course (EOC) tests for five core subjects across several years between students in the 4×4 block and traditionally scheduled grades 9-12 high schools?

Sample and Population

The sample includes about 640,000 North Carolina students in 214 grades 9-12 high schools (special educational and alternative high schools were excluded) from 1993 to 2000. Among those 214 schools, 68 are the traditionally scheduled schools, and 146 are 4×4 block scheduled schools that started operating the 4×4 schedule in 1995, 1996, or 1997. These years were the peak beginning use of block scheduling and include most of the block scheduled 9-12 high schools in the state. The target population to which these results might generalize includes students in regular grades 9-12 high schools in the United States that have similar socioeconomic and educational status.

Variables and Measurement Instruments

The EOC tests for five core subjects – Algebra I (A1), English I (E1), Biology (Bio), Economic, Legal, & Political Systems (ELP), and US History (USH) – are the focus of the study. Based on the Evaluation Report completed by Evaluation and Assessment Laboratory of the University of Alabama (1996), North Carolina EOC Tests have high test-retest reliability, content validity and construct validity. Since types of scores used in various EOC tests have changed over the years, the students' original EOC test scores for 1993 to 2000 were converted to standard T-scores, with a mean of 50 and a standard deviation of 10.

The school average mean T-score for 1997, 1998, 1999 and 2000 is the dependent variable (for both block and traditionally scheduled schools). This dependent variable shows the most recent years' performance. For the block scheduled schools, this represents the overall performance after implementing the block schedule for several years. Scheduling status is the independent variable.

The school average mean T-score for 1993 and 1994 (Pre_Tscore) is used as a pre-test score. The number of block schools that started in those two years were small. They are excluded from this study, thus allowing the average T-score for these years to serve as one control variable. The mean percentage of minority students (Pct_MS), mean percentage of students with free reduced-price lunch (Pct_FRL), and mean percentage of students whose parents' education level is at high school diploma or lower (Pct_Low-PEL) from 1997 to 2000 are concomitant variables that can be obtained from the state testing database. These are very important variables that strongly relate to student academic performance. The absolute value of correlation coefficients between the above four variables and the dependent variable, mean T-score, for five core subject EOC tests are around .6 - .8 for Pre_Tscore, .6 - .8 for Pct_MS, .6 - .7 for Pct_Low-PEL, and .5 - .7 for Pct_FRL.

Analysis Method

According to Ary, Jacobs, and Razavieh (1990), it is possible to partially control concomitant variables in ex post facto research. They indicated that some strategies could improve the quality of ex post facto research, although none of these strategies can adequately compensate for the inherent weakness of such research, namely, lack of control of the independent variable. Hence, the key issue in ex post facto research is to control as many identified concomitant variables as possible.

ANCOVA. There is a great deal of discussion and controversy about the use of analysis of covariance (ANCOVA) in the situation where there are intact groups in social science research. However, ANCOVA is often used in research situations involving unequal concomitant variable means, including the use of intact groups in educational research (Kirk, 1995). Romax (1992) stated that we are not to suggest that ANCOVA should never be used with intact groups, but interpretation of the results should be made with care. Also, Maxwell and Delaney (2000) noted that although ANCOVA can be used in an effort to make intact groups that

differ in known ways more comparable, the adjustment may well exaggerate differences on some dimensions and reduce differences on others.

After examining and eliminating several key concerns, ANCOVA was chosen as an appropriate method to statistically control the concomitant variables in this study:

Selection of Covariates. Based on Romax (1992), if the correlation coefficient between a concomitant variable, which was measured without error and not influenced by the independent variable, and a dependent variable is greater than .6, this concomitant variable can be used as a covariate for obtaining the most powerful and precise design. According to this criterion, as well as multiple regression results in terms of the extent of increase of R Square (variance accounted for) by adding a covariate, four covariates were selected. They are Pre_Tscore, Pct_Low-PEL, Pct_MS, and Pct_FRL.

Examination of Violation of Assumptions. An examination of violation of assumptions must be done before using ANCOVA results. A number of detailed examinations of random and independent errors, homogeneity of variance, linearity, and, especially, homogeneity of regression slopes were thoroughly conducted for all ANCOVAs. The results showed, overall, that the violation of these assumptions is not of concern.

Results

Descriptive Analysis Results

These results describe the 4 x 4 block and traditionally scheduled schools prior to applying statistical adjustment (ANCOVA).

1. The 4x4 scheduled schools had higher percentages in FRL and low parent education level (about 8% difference for FRL and 15% for low parent education level), and lower percentages in minority ethnicities (about 5% difference) in comparison to the traditionally scheduled schools (See Figure 1 to Figure 3).

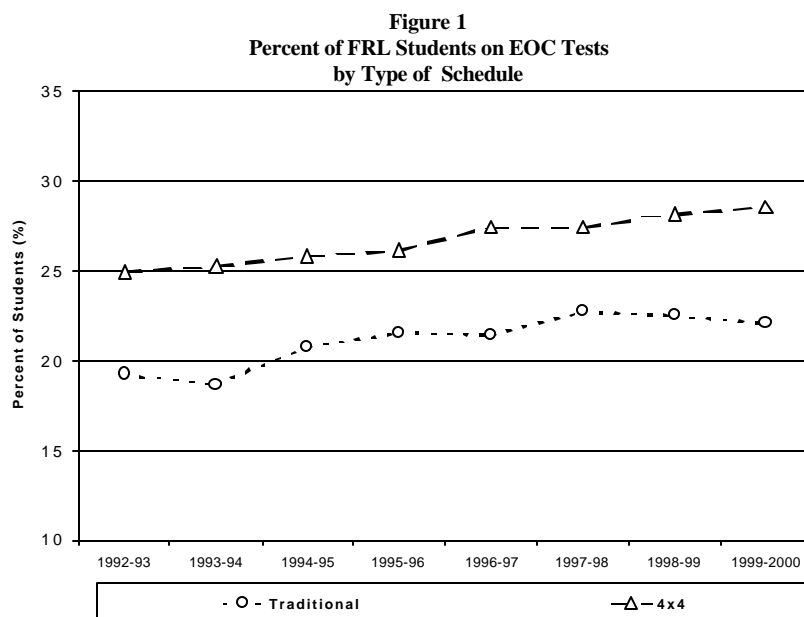


Figure 2
Percent of Students whose Parent Education Level at High School or Lower on EOC Tests by Type of Schedule

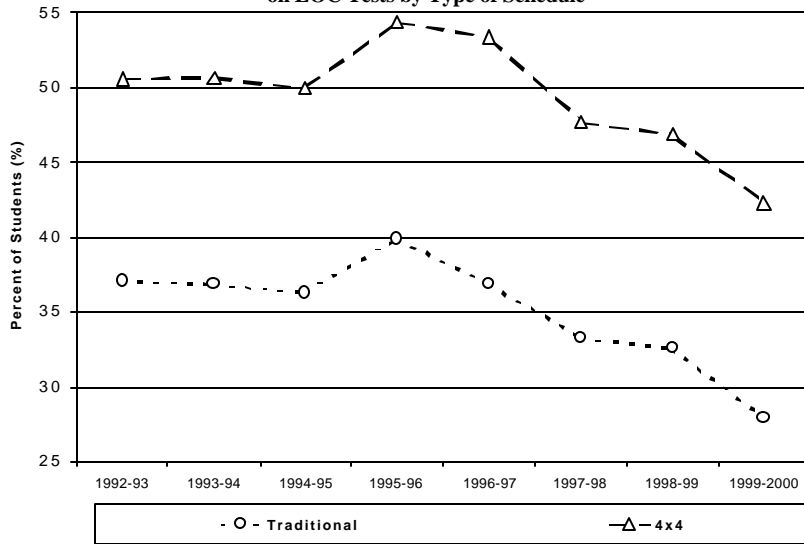
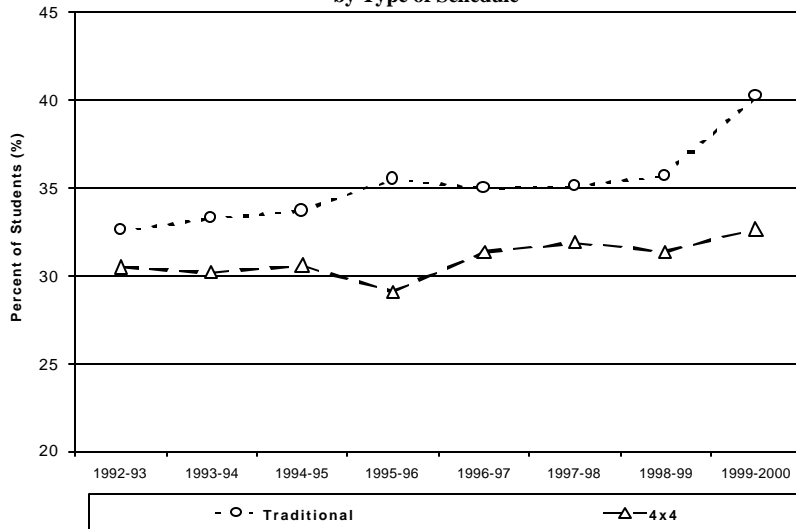
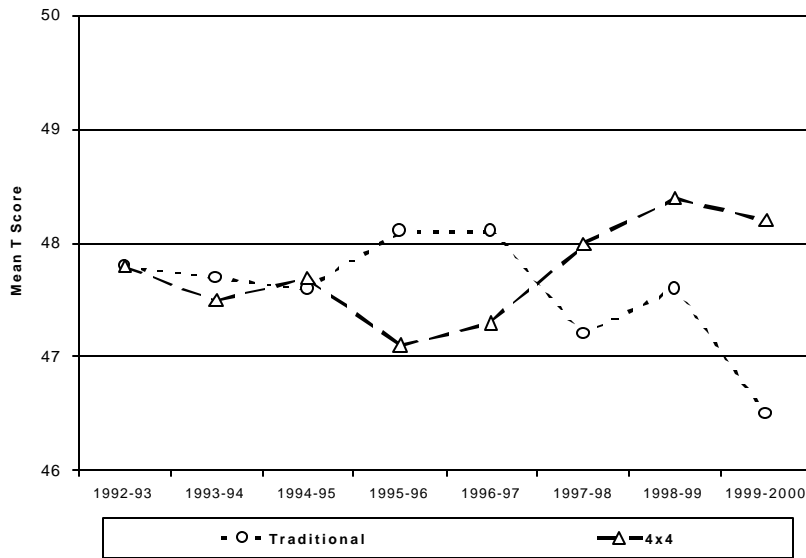


Figure 3
Percent of Minority Students on EOC Tests by Type of Schedule



2. Before the implementing the 4x4 schedule, the 4x4 scheduled schools had lower mean T-scores for 1993 & 1994 in comparison to the traditionally scheduled schools in all five EOC subject tests (See "Pre_T Score" column in Figure 9 to Figure 13).
3. There has been an upward trend of mean T-scores for the 4x4 scheduled schools, and a downward trend for the traditionally scheduled schools in Algebra I since 1996. Students in the 4x4 scheduled schools outperformed students in the traditionally scheduled schools in the most recent three consecutive years for Algebra I (See Figure 4).

Figure 4
Mean T-score by Type of Schedule - Algebra I



4. For English I, Biology, ELP and US History, students in the traditionally scheduled schools have outperformed students in the 4x4 scheduled schools since 1994-95. However, for English I, Biology, and ELP, there have been upward trends of mean T-scores from 1996 to 1999, a drop in 2000 for the 4x4 scheduled schools, and an opposite trend for the traditionally scheduled schools. There has been an upward trend for the 4x4 schools, and a downward trend for the traditional schools in US history since 1998 (See Figure 5 to Figure 8).

Figure 5
Mean T-score by Type of Schedule - English I

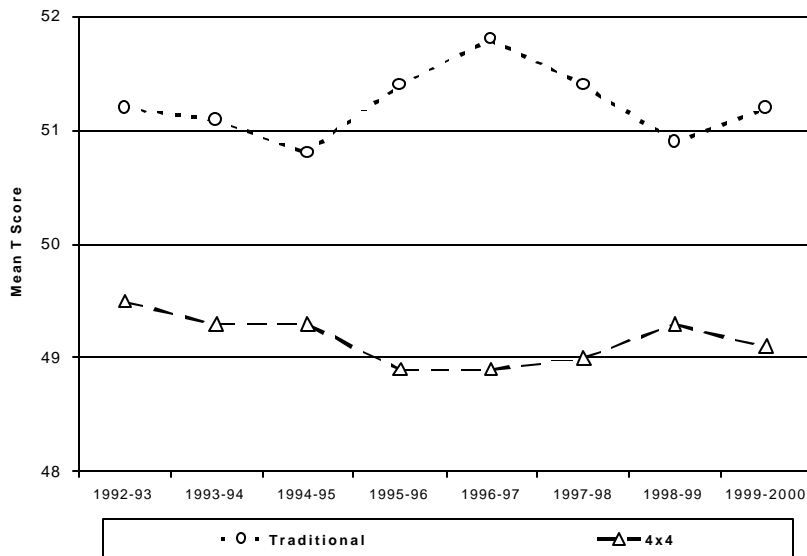


Figure 6
Mean T-score by Type of Schedule - Biology

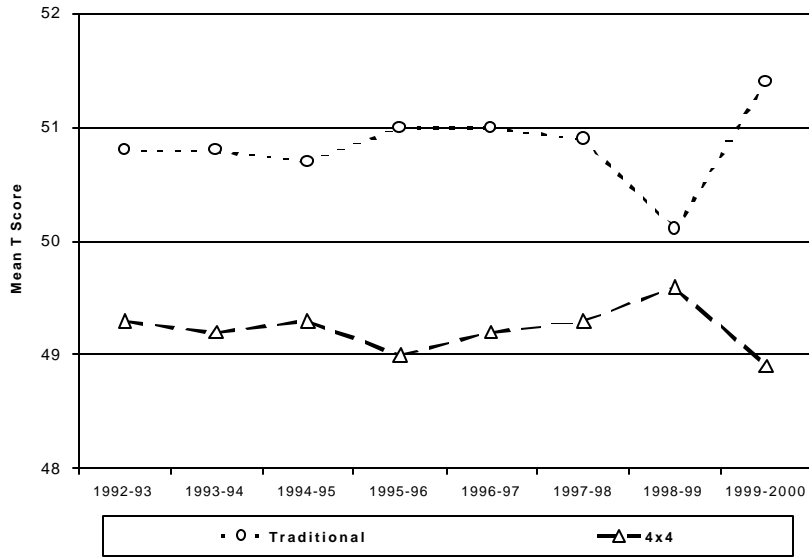


Figure 7
Mean T-score by Type of Schedule - ELP

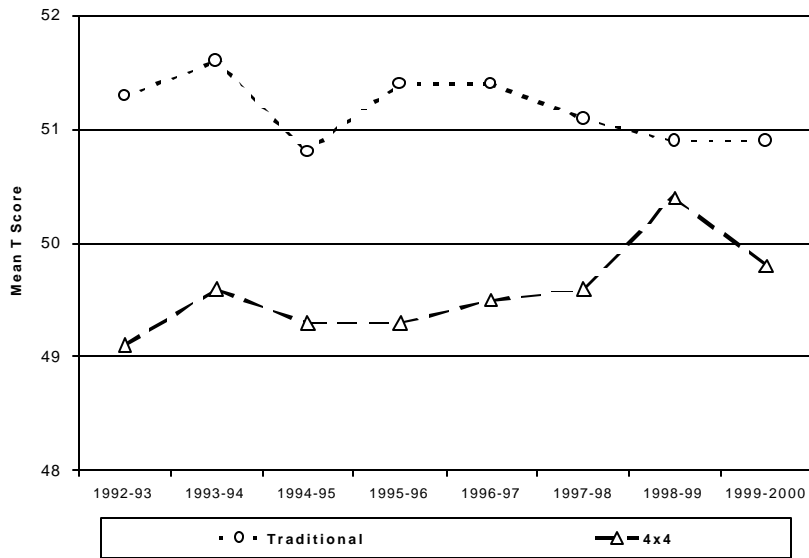
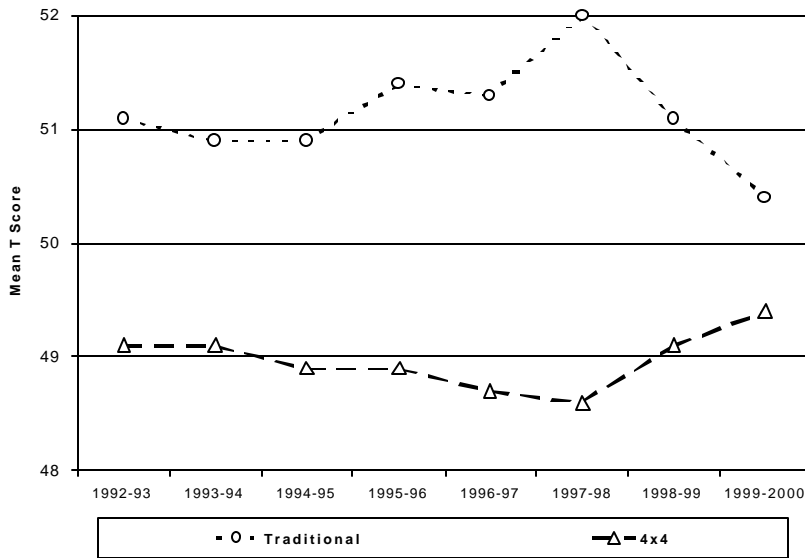


Figure 8
Mean T-score by Type of Schedule - US History

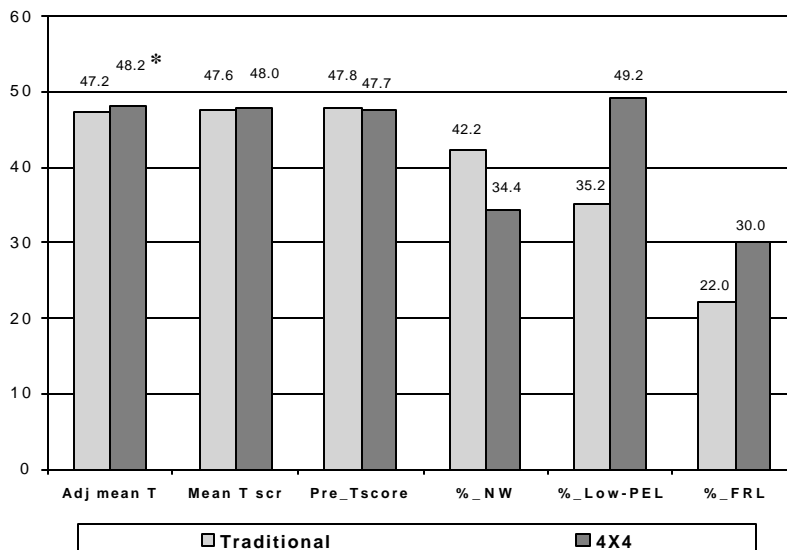


ANCOVA Results

After applying Analysis of Covariance, which controls for the concomitant variables as described, the following results were found. Column 1 - "Adj mean T" - in Figures 9-13 shows the average adjusted means for 1997-2000 along with the significance level.

1. For the Algebra I, there was a significant difference between students in the 4x4 and traditionally scheduled schools. Students in the 4x4 schools significantly outperformed students in the traditional schools across four years from 1997 to 2000 (See Figure 9).

Figure 9
ANCOVA Results -- Algebra I



2. For English I, Biology, ELP, and US History, there were no significant differences between students in the 4x4 and traditionally scheduled schools. However, students in the 4x4 scheduled schools had slightly higher adjusted mean T-scores than students in the traditionally scheduled schools, except for US History (See Figure 10 to Figure 13).

Figure 10
ANCOVA Results -- English I

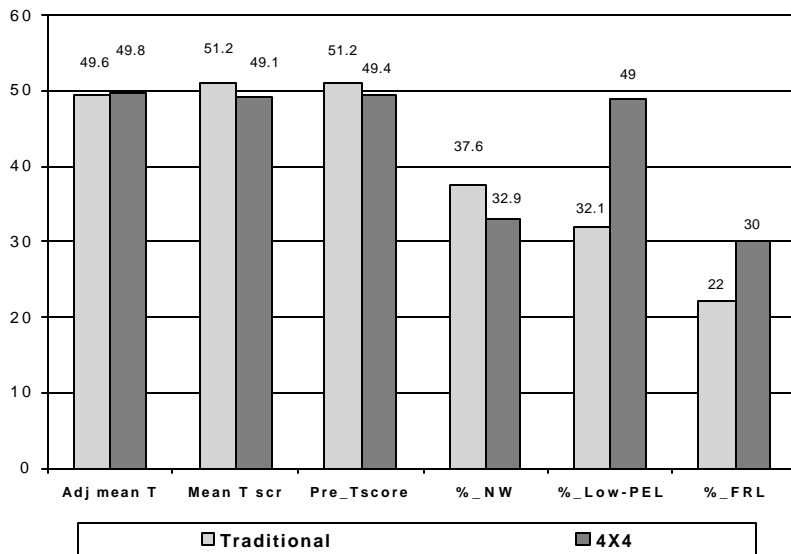


Figure 11
ANCOVA Results -- Biology

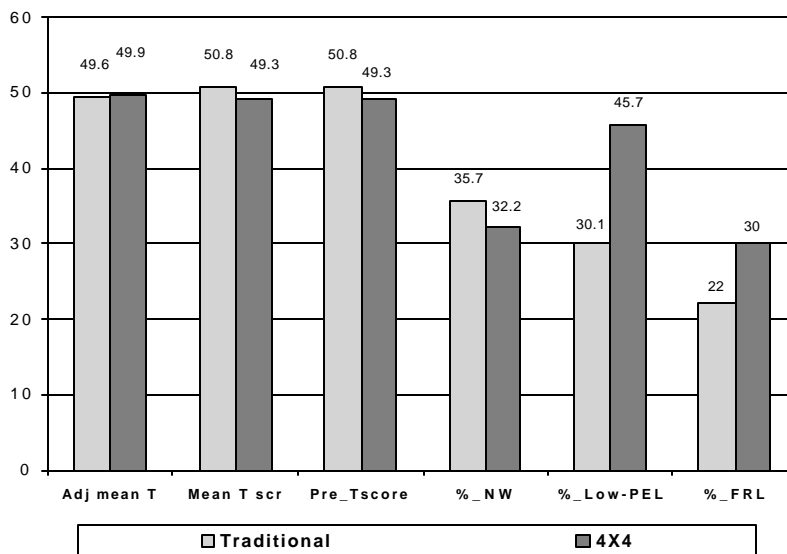


Figure 12
ANCOVA Results -- ELP

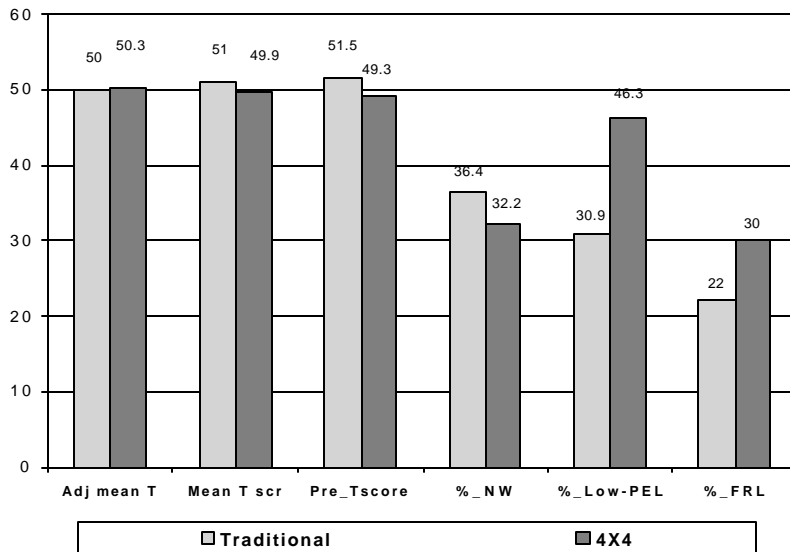
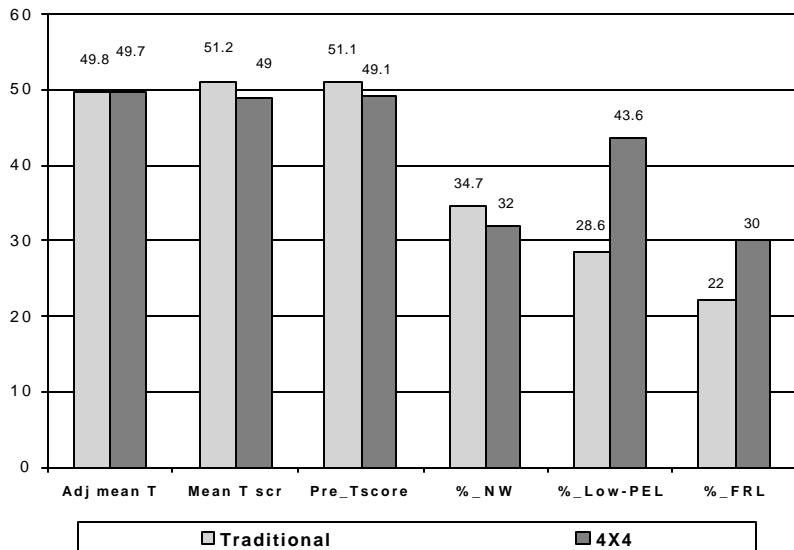


Figure 13
ANCOVA Results -- US History



Conclusion

These findings show that the 4×4 schedule has a positive effect on student performance in Algebra I. The 4×4 schedule might have some positive effect on student performance in EOC tests of English I, Biology, ELP, and US History after this schedule has been implemented for 2 to 3 years. However, more years of data are needed to obtain conclusive findings. Some findings of this study support previous studies in certain areas, such as US History in the study of Hess et al. (1998) and English in the study of Veal & Schrieber (2000). Other findings are contrary to previous studies, such as Algebra I in the studies of Wronkovich et al. (1997), Cobb et

al. (1999), and Veal & Schrieber (2000), Biology in the study of Hess et al. (1998), and English I in the studies of Cobb et al. (1999) and Veal & Schrieber (2000). Analyzing longitudinal data versus cross-sectional data might cause the differences. Also several important factors, such as teachers with different teaching methods, students at different academic levels, courses with different criterion and standards, assessment with different purposes and formats, and interactions among these factors could cause the differences.

No matter what kind of scheduling is used, what happens between individual teachers and students in classrooms is still most important for teaching and learning. Mechanically altering the manner in which we schedule schools will not ensure better instruction by teachers or increased learning by students (Canady & Rettig, 1995). While there may be other perceived benefits of the block schedule (e.g., more available courses, fewer possible discipline, interactions among students), scheduling by itself will not automatically improve the learning climate, the nature of instruction, and student outcomes. It may provide some of the necessary, but not sufficient, conditions for these improvements. Schools should carefully plan the use of time and provide appropriate staff development, especially when they change schedules to accomplish specific goals.

Block scheduling is still fairly new in the United States although it has spread rapidly. Block scheduling may take years to show real effects (good or bad). Quantitative research about impact of the high school schedule on teaching and learning is badly needed, especially research that includes the factors of instructional method, student academic level, course criterion and standards, and assessment method.

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