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Breaking from Tradition: Unfulfilled Promises of Block Scheduling in Science

Using a national survey of more than 7,000 students from 128 different college introductory science courses, the authors compared students who experienced Block scheduling and Traditional scheduling in high school.

With 66.7 % of high school graduates from the class of 2004 enrolled in colleges or universities (United States Department of Labor, July 2005), the importance of high school as a means to prepare students for a successful college experience is evident. Educators and administrators strive to find a schedule that allows for greater retention, provides for adequate content coverage, and produces high academic achievement across all subject areas. Prisoners of Time and the No Child Left Behind initiative focused attention on educational topics like the intensity of class time and the restructuring of school days (NECTL, 1994). The National Science Education Standards (Teaching Standard D) state that "Teachers must: …Structure the time available so that students are able to engage in extended investigations" (NRC, 1996, p. 43). Having these goals in mind, many schools have shifted from Traditional scheduling systems to Block scheduling. In 1996 Rettig and Canady estimated that approximately 50% of American secondary schools were on some form of Block scheduling.

Much of the existing literature views the Block vs. Traditional scheduling issue as an "either/or" debate, with voices on both sides of the scheduling divide (Canady & Rettig, 1995; Lindsay, 2000). Kienholz, Segall, and Yellin (2003) commented that Block scheduling allowed students to learn material at a "more relaxed, less frenetic pace" (p. 64) and that it enhanced the "environment for learning for both teacher and students" (p. 65). The extended class periods and modified scheduling frameworks necessitate a change in instructional practice as teachers shift away from traditional 50 minute classes. Some argue that the Block format increases scheduling flexibility, and is more conducive to team teaching, multidisciplinary classes, labs, and fieldwork (Center for Education Reform, 1996). Queen (2000) discussed a number of methodologies including the use of case method, synectics, and concept attainment as well-suited to use within a Block schedule. Day, Ivanov, and Binkley (1996) reported the benefits of increased attendance, decreased failure rate, and an improved quality of instruction that came as a result of switching to a Block schedule. In terms of using the extended class period for science instruction, many articles have been published in science education journals focusing on creative lesson plans and time usage within a Block schedule (e.g. Barnes, Straton & Ukena, 1996; Bohince, 1996; Cooper, 1996; Craven, 2001; Day et al, 1996; Frank, 2002; Rapp, 1997).

Although Block scheduling reduces the amount of transition time between classes, it often reduces the total class time.

On the opposite side of the scheduling debate, other studies reported that there was no evidence Block scheduling led to meaningful teaching innovations that resulted in higher student achievement (Center for Education Reform, 1996). In many cases, longer class periods meet fewer times per week, and the overall result is less total class time (Louden & Hounshell, 1998). The existing literature often cited continued use of instructional practices better suited for Traditional schedules and disuse of instructional practices better suited to Block-type schedules as reasons why Block scheduling plans have not produced improvement in student achievement (Hackmann & Schmitt, 1997). Other important issues presented in the literature involved variations in the frequency of particular teaching formats used in different scheduling plans, and whether or not Block students were better prepared for future academic achievement than their peers in Traditional schedules (Knight, DeLeon, & Smith, 1999; Lawrence & McPherson, 2000).

Overall, the results of the study indicated the students felt that individual teachers played a much greater role in their preparation (positively or negatively) than did the scheduling format.

In a study focusing on science courses taught at a high school using Traditional, Block, and Hybrid scheduling, Veal (2000) discovered that there were benefits and drawbacks to each of the scheduling models. He found that while teachers reported some of the benefits addressed in the research literature on Block scheduling, they also reported challenges and tradeoffs when attempting to improve classroom practice. He reported that classes meeting on a Block schedule had 22 % less in-class time than those in the Traditional schedule. This reduced class time led to an increased pace of instruction in the Block classes and caused frequent use of lectures to cover material in a more efficient manner. These results beg the question of how this quickened pace affects students of varied ability levels.

Only a few large-scale studies have published research regarding the effects of scheduling format. Rice, Croninger, and Roellke (2002) presented evidence from an analysis of the National Education Longitudinal Study: 1988 (NELS:1988) data. They looked at the effect of block scheduling on math achievement and found that students taking part in Block scheduled courses performed below those in traditional classes. Jenkins, Queen, and Algozzine (2002) conducted a study involving 2,167 high school teachers in North Carolina. The authors concluded that the teachers in their survey did not use different instructional methods based on whether they were in Traditional or Block schedules. Nichols (2005) completed a longitudinal study focusing on English and Language Arts in schools within a single district that were changing over from Traditional scheduling to a Block format. The author reported only a slight overall increase for student achievement after conversion of these schools to a Block schedule. The largest study, conducted by Deuel (1999), investigated the implementation of a Block schedule at schools in an urban school district collecting data before and after the change. Deuel concluded that student achievement increased with the introduction of Block scheduling; however, the author noted that there were not any differences between the percentages of students passing science courses from either schedule format. Overall, these large-scale studies did not find convincing evidence that a change to Block scheduling leads to greater understanding or achievement by students.

None of the studies mentioned assessed outcomes of participation in a Block schedule over an extended period of time. Salvaterra, Lare, Gnall, and Adams (1999) performed a qualitative study investigating perceptions regarding preparation for college math, science and foreign language of students who had studied in high schools using Block scheduling. Overall, the results of the study indicated the students felt that individual teachers played a much greater role in their preparation (positively or negatively) than did the scheduling format.

Any school official looking to implement a scheduling change is faced with a literature base that is polarized.

Zepeda and Mayers (2006) conducted a literature review of 58 empirically-based research articles involving Block scheduling. The authors found that overall, perceptions of Block scheduling were positive amongst the majority of studies they reviewed, but that the effect of a Block schedule on student achievement was mixed, with nearly equal numbers of reports of positive and negative effects. They concluded that additional longitudinal studies were needed and the authors found no studies looking at the effect that high school scheduling format had on college performance.

Any school official looking to implement a scheduling change is faced with a literature base that is polarized. Many of the articles on either side of the scheduling schism comment on a few of the benefits and drawbacks to each approach, but few of the research articles deal specifically with the long term effects of Block scheduling in high school science courses. Provided this research base, we sought to address the following questions:

1) Do students who participated in a Block science class report instructional practices at frequencies different from their counterparts in Traditional classes?

2) Controlling for secondary science achievement and differences in backgrounds, is introductory college science performance associated with students' reported participation in high school scheduling plans? Are the relationships observed between scheduling plans and instructional practice associated with introductory college science performance?

The use of a large sample in this study provided an opportunity to look at students with a wide range of backgrounds and to see if, and how, their high school scheduling framework affected performance in introductory college science.

Methods

Many high school science teachers consider preparation for college science as a major objective in their courses (Hoffer, Quinn, & Suter, 1996). With this idea in mind, Factors Influencing College Science Success (Project FICSS) collected data from college students that included surveys and introductory college science grades (Sadler & Tai, 2001). Project FICSS collected survey data from students in 128 different first semester introductory college biology, chemistry, and physics courses. These courses were taught at 55 four-year colleges and universities (36 public and 19 private) in 33 states during the fall semesters of 2002 and 2003. The student enrollments at these institutions ranged from small liberal arts colleges to large state universities and included historically black colleges and universities, and women's colleges. Faculty were asked to participate in the survey, and 29 biology departments, 31 chemistry departments, and 37 physics departments agreed. The sample totals were: 2,754 biology surveys, 3,521 chemistry surveys, and 1,903 physics surveys.

The format most likely encountered by introductory science students is a large lecture-based class, with smaller recitation/tutorial sections, and a separate laboratory session; therefore, this is the only course type included in this study. The surveys were administered during class meetings and professors entered the students' final course grades on the surveys before returning them to the researchers.

The frequencies of teaching methods reported by students in Traditional and both Block scheduling plans are strikingly similar.

Three different scheduling plans were included in this analysis: traditional scheduling plans, A/B Block plans, and 4:4 Block plans. Traditional scheduling plans range from six to eight periods a day for an entire year with class time spanning from 45 to 55 minutes per period. One of the most common Block scheduling plans is the 4:4 Block. This plan involves four classes that meet for 75 to 90 minutes each period every day for half a year. Another of the Block options is A/B Block scheduling, which is three to four classes that meet every other day for an entire year. On an A/B Block plan, class times can range from 75 to 90 minutes. (Canady & Rettig, 1995) For ease of comparison, other hybrid schedules that were less-prominent were excluded from this analysis.

Results and Discussion

From the larger FICSS survey, a number of questions were selected for this analysis based on the students' backgrounds, high school experiences, and test scores. First, we present descriptive statistics for the sample. Classified by scheduling type, 4,160 respondents reported participating in traditional scheduling plans, 1,672 reported 4:4 Block plans, and 1,513 respondents reported A/B Block plans while in high school. Because we were looking at the effects of high school scheduling plans, it's important to comment on the geographic distribution of the students completing surveys based on hometown rather than college location. The sample included students from all 50 states, Washington D.C., and Puerto Rico, with 27 states each having 50 or more respondents.

To answer the first research question, we looked for variations in teaching methods across different scheduling plans. For this analysis, a comparison was made between the following measures of instructional methodologies in high school science: 1) number of labs per month; 2) number of demonstrations per week; 3) frequency of lectures, 4) whole class discussions, 5) small group activities, 6) individual work, and 7) peer tutoring; and 8) class time spent on standardized exam preparation. The instructional practices were compared for frequency of usage under each type of scheduling plan and are presented in Table 1.

The frequencies of teaching methods reported by students in Traditional and both Block scheduling plans are strikingly similar. Although there are slight variations across the plans, it appears that no one scheduling plan stands out as a leader for use of these pedagogical methods. It must be noted that the frequency figures for A/B Block might be confounded because the survey choices of 2-3 times per week and Everyday can be seen as equivalent in that schedule.

One common criticism of science teachers in Block scheduling plans was that they were not using instructional methods that would take best advantage of the extended class times.

The second research question investigated the existence of a connection between high school scheduling plans and college performance while accounting for differences in student backgrounds and academic achievement. The question also called for analyses regarding interactive associations between scheduling plans and instructional practices. We chose to use multiple linear regression for this analysis. For the purposes of interpretation, we graphed the results in Figure 1 and 2.

Figure 1 compares differences in predicted college grades for prototypical students with a range of high school science grades across the three scheduling plans. For Traditional and 4:4 Block plans, the findings show similar trends, with 4:4 Block plan participants associated with grades incrementally (-0.81) lower than Traditional plan students. Interestingly, an interaction exists for students who experienced A/B Block scheduling in high school. Higher achieving A/B Block students appear to be associated with slightly higher college science grades than students in all other schedule plans; however, lower achieving students were predicted to earn grades lower than their peers from Traditional and 4:4 Block plans. No more than a three-point difference separates the predicted college science grades among the three scheduling plans within each level of science achievement. In other words, the predicted score for a prototypical "A" student in any plan is within 3 points of all the other predicted scores for that student, with the largest difference being only 2.30 points between

Table 1: Pedagogical Frequency by High School Scheduling Plan

		Scheduling Plan		
Pedagogical Method	**Frequency of Use**	**Traditional[a]**	**A/B Block[b]**	**4:4 Block[c]**
# of Labs/Month	No Labs/Month	8%	7%	11%
	1 Lab/Month	20%	19%	16%
	2 Labs/Month	25%	25%	23%
	3 Labs/Month	16%	19%	19%
	4 Labs/Month	19%	19%	19%
	5 or More Labs/Month	11%	11%	12%
# of Demonstrations/Week	None	11%	10%	10%
	1 Demo/Week	37%	38%	34%
	2 Demos/Week	24%	30%	26%
	3 Demos/Week	17%	16%	18%
	4 Demos/Week	5%	3%	5%
	More than 4 Demos/Week	6%	4%	7%
Frequency of Lecture	Very Rarely/ Once per month	4%	4%	5%
	Once/Week	4%	7%	4%
	2-3 times/Week	19%	31%	19%
	Everyday	73%	58%	71%
Whole Class Discussions	Very Rarely/ Once per month	32%	35%	30%
	Once/Week	23%	25%	22%
	2-3 times/Week	24%	22%	26%
	Everyday	21%	17%	22%
Small Groups	Very Rarely/ Once per month	25%	24%	19%
	Once/Week	37%	40%	34%
	2-3 times/Week	28%	26%	34%
	Everyday	10%	11%	13%
Individual Work	Very Rarely/ Once per month	24%	28%	23%
	Once/Week	27%	31%	24%
	2-3 times/Week	31%	28%	31%
	Everyday	19%	14%	21%
Peer Tutoring	Very Rarely/ Once per month	74%	73%	74%
	Once/Week	13%	14%	12%
	2-3 times/Week	8%	9%	8%
	Everyday	6%	5%	6%
Exam Prep	Very Rarely/ Once per month	81%	80%	79%
	Once/Week	12%	12%	14%
	2-3 times/Week	5%	4%	5%
	Everyday	3%	3%	2%

[a] Traditional $n_{average}$ = 4,061. [b] A/B Block $n_{average}$ = 1,469. [c] 4:4 Block $n_{average}$ = 1,615.

Figure 1: Comparison of Predicted Final Introductory College Science Course Grade Across Three Scheduling Plans

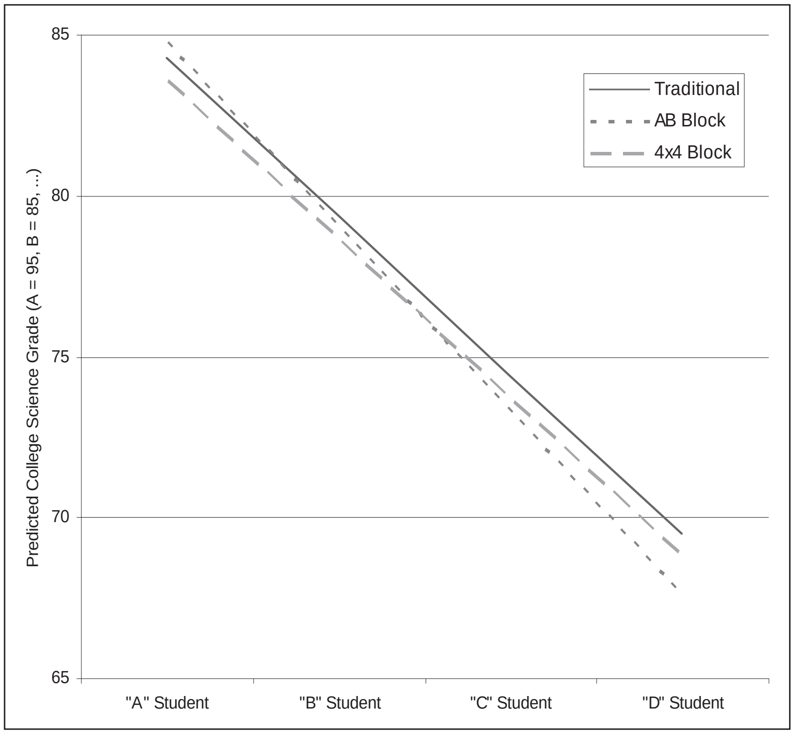
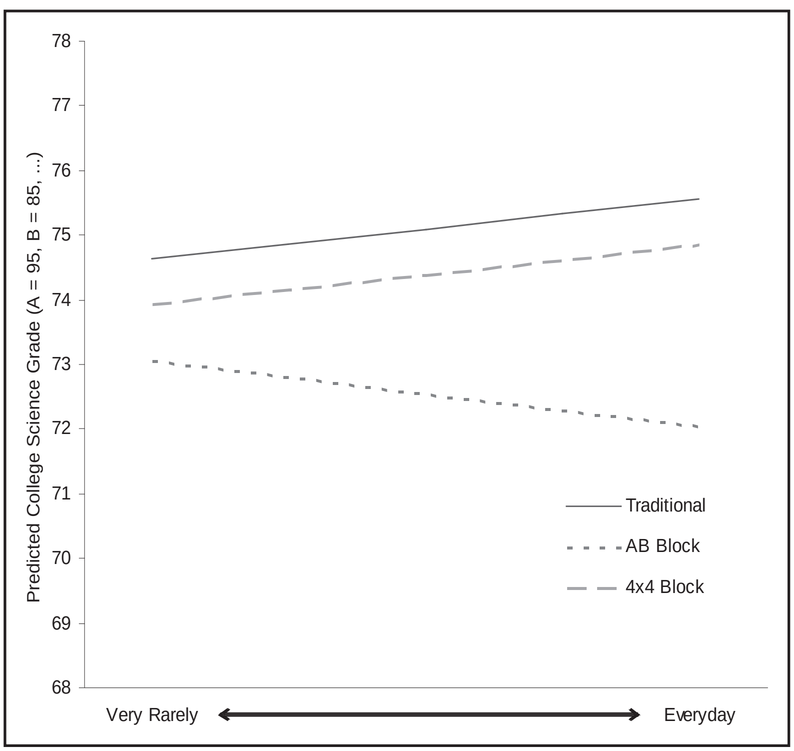


Figure 2: Comparison of Predicted College Grades for Scheduling Plans Across Differing Levels of Peer Tutoring



plans. The existing minor variations in predicted college grades indicate that there are no meaningful differences in college performance between the students from different scheduling formats.

A common criticism of Block scheduling is that teachers are not applying the methodologies that capitalize on its advantages.

Our investigation also included an analysis of the interactions between the frequencies of the eight instructional methodologies previously listed and the three scheduling plans. One common criticism of science teachers in Block scheduling plans was that they were not using instructional methods that would take best advantage of the extended class times. The interaction analysis allowed us to assess whether differences in college performance exist among students who reported different frequencies of particular instructional methods, some of which have been cited as more advantageous to Block periods. Of the eight instructional practices analyzed, only one produced a statistically significant outcome, peer tutoring. Non-significance suggests that for the other seven instructional methodologies there did not appear to be an associated difference in college performance. The results for peer tutoring are graphed in Figure 2. They show that for Traditional and 4:4 scheduling plans, higher levels of peer tutoring were typically associated with higher levels of college performance, with Traditional students associated with the highest college performance. A significant interaction appears for A/B Block and peer tutoring, predicting that A/B Block students reporting higher levels of peer tutoring did worse, a trend in opposition to the other plans.

In summary, this analysis does not find evidence for the purported advantages associated with Block scheduling plans in terms of college science performance**.** Students from all three scheduling plans reported similar frequencies for the selected pedagogical methods. Using introductory college science performance as an outcome measure, no real differences were demonstrated across the scheduling formats. Finally, only one of the selected pedagogical methods showed an interaction with college performance and the variations there were modest.

Clearly, for science teachers, the allure of having more time to involve students in a laboratory assignment or other extended activities is appealing and the findings of this study do not disqualify extended class time as a benefit per se.

Conclusions

The aim of this investigation is to present information that will allow teachers and administrators to make a more informed decision about the various scheduling plans and their performance in preparing students in secondary science. We studied whether students who participated in a Block science class in high school reported instructional methodologies at frequencies different from their counterparts in Traditional science classes. The data indicate that there are no significant differences between the frequencies of methodologies reported across Traditional schedules and two common forms of Block scheduling. In fact, the scheduling plans were very similar in terms of frequency of instructional practices.

Next, we investigated the associations between student experiences in varied scheduling plans and the performance of these students in introductory college science courses. In terms of college science performance, the results showed no more than a 3 point difference among the scheduling plans. The differences amounted to only about one third of a letter grade, with Traditional plans associated with the highest level of college science performance. For A/B Block students, the results produced an interaction that suggested higher performing science students were advantaged in their college preparation, while lower performing students were disadvantaged. These findings may suggest that Block scheduling does not equally address the needs of all students.

A common criticism of Block scheduling is that teachers are not applying the methodologies that capitalize on its advantages. Our findings appear to support this contention. Therefore, we chose to perform an interaction analysis between scheduling plans and pedagogy. Our findings suggest that even in the cases where "Block-advantaged" methods are used at higher frequencies, student performance does not appear to differ much from Traditional scheduling plan outcomes.

There are several issues our study could not directly address and therefore present limitations for our conclusions. One issue is that college science classes may be more similar to a Traditional format and therefore would benefit those students over those who experienced Block plans. However, college classes rarely meet every day; they commonly have extended laboratory and class periods; and they are typically structured to be completed in a semester or quarter; all characteristics that are more similar to a Block format. In fact, it may be argued that college course schedules are more similar in structure to some Block scheduling plans, than Traditional scheduling plans. Another concern may arise from the unbalanced research design, which is typical of large-scale survey studies. The students were selected to be representative of introductory college science students and not based on their high school scheduling plans. However, given that the sample included large numbers of students reporting Block scheduling plans (i.e. A/B, n = 1,513; 4:4, n = 1,672) these data still allow for a robust analysis.

Overall, these findings raise questions about the capacity of Block scheduling plans to deliver an instructional advantage. Clearly, for science teachers, the allure of having more time to involve students in a laboratory assignment or other extended activities is appealing and the findings of this study do not disqualify extended class time as a benefit per se. However, this analysis does offer evidence that implementation of Block scheduling plans does not result in stronger performance in introductory college science courses, even when coupled with instructional methods cited as best practices for extended class periods. Certainly, extending class time catalyzes a series of other changes in schools. It may be that the ancillary changes necessary to accommodate longer class periods offset any advantage that extended periods offer. This study only analyzed Block plans as a whole. Further research is necessary to provide a more detailed picture of how the various characteristics of scheduling plans impact students' learning outcomes. But what is clear is that Block scheduling plans on the whole did not deliver on their claimed benefits.

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