High School Schedule Changes and the Effect of Lost Instructional Time on Achievement

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High school students who change their class schedules after the start of the school year may miss class time before their schedules are finalized. This loss of class time is expected to lead to a loss of learning opportunities, and thus to lower student achievement. We examine a school with an unexpectedly large number of such schedule changes. Contrary to our expectation, students who were not in class because they were changing schedules had achievement equal to students who were in class, even when the students changing schedules missed many days of class. While this indicates that students were not penalized for schedule changes, it also suggests that all students had reduced opportunities to learn.

Introduction

Time is an important school resource. Research consistently shows that more instructional time leads to higher achievement (see, for example, Wiley, 1976; Karweit and Slavin, 1981; Dreeben & Gamoran, 1986). By itself, time is not sufficient for learning. Numerous other factors, including individual student ability, teachers' quality of instruction, and school organization, are involved (Carroll, 1985; Hallinan, 1987; Kilgore & Pendleton, 1993). However, time is a minimum condition for learning because it sets the boundaries for teachers' opportunities to teach and students' opportunities to learn. Without time available for the teaching of academic material, students will not be exposed to such material, and therefore will be unable to learn it. For this reason, school policies that decrease the amount of time available for teaching and learning should be discouraged.

Time is a limited school resource and, in high schools, is structured according to both school and student schedules. Teachers' schedules set the maximum amount of instructional time they will have for a particular class. Students' schedules set the maximum number of hours they will be exposed to that course material during the school day. The typical teacher in high school has approximately 75 hours of class time to present a semester's worth of material (National Education Commission on Time and Learning, 1994).

The amount of classroom time available for learning is reduced in many ways. Whole school events such as fire drills, assemblies, and school announcements may remove students from the classroom or otherwise prevent instruction during that time. Within the classroom, teachers spend time on classroom management, taking attendance, and restoring order after disruptions. Teachers also vary in their effectiveness at restoring order quickly and in moving swiftly from classroom management back to teaching and learning. All of these circumstances affect the amount of time available for teaching and learning.

Such losses of instructional time are normal. Fire drills, school assemblies, school announcements, and teachers' effective use of time are part of every school. Schools do not attempt to eliminate all interruptions of instructional time, but try to ensure that such interruptions are either important or minimized.

Other losses of instructional time are more problematic. In particular, some losses of instructional time can be a direct but unintended result of school policies or practices. Schedule changes are one such area where school policies may result in a needless loss of instructional time, to the potential detriment of student learning.

Under ideal conditions, every student in a high school would begin each semester with a complete and correct schedule. This would allow students to attend all of their classes and present teachers with a stable classroom group. In practice, this ideal is rarely, if ever, realized. Some students start the year with incomplete or incorrect schedules, which must be corrected. Such schedule errors and changes can cause students to miss classes until their schedules are finalized. To the extent that effective teaching and learning occur in the classes missed, the time lost due to schedule changes will have negative consequences for student progress. If school policies or practices contribute to the need for student schedule changes, then changes to these policies and practices could improve student learning.

SCHEDULING AND Schedule Changes

This paper investigates the loss of class time due to scheduling practices using a quantitative case study of one high school. We first describe the school's usual scheduling procedure and note practices that increase missed class time due to schedule changes. We next discuss more extensive investigations of one school year that was highly unusual in terms of schedule changes. Finally, we analyze the effect of schedule changes on student performance and conclude by considering the implications.

The Scheduling Process, Normal Errors, and Schedule Changes

We will refer to the high school studied here as River High School. It is one of several public high schools in a midsized Midwestern city. Scheduling is managed by school counselors, who preregister students in the spring who are planning to attend that school the following fall. Some student registration errors invariably occur. For example, students may not register for enough classes, students may register for courses without having fulfilled the prerequisites, and students may register for nonexistent courses. The counselors make some efforts to catch such errors during this preregistration period, although they report that they never correct all of them.

Student preregistration is used to determine which courses will be offered and the number of sections of each course. Based on preregistration, the high school's head counselor creates a master schedule, assigning teachers and courses to class periods. This preliminary master schedule is completed in June.

Due to financial restrictions and limited student interest, a significant number of courses have only one section, that is, these courses are offered during only one period. Under any master schedule, a number of single section courses will be scheduled for every class period in the day. Thus, some students will have schedule conflicts because they preregister for courses that require them to be in different classrooms at the same time. When many students are affected by such schedule conflicts, the head counselor revises the master schedule to reduce the number of conflicts.

Since there are a limited number of teachers as well as restrictions on class size, not all schedule conflicts can be eliminated. One of the head counselors at River High School reported that in a typical year, he stopped revising the master schedule in the spring when approximately 250 students (about 20% percent of the student body) had problems with their schedules due to schedule conflicts or student errors in preregistration. The process of resolving these remaining schedule conflicts and other schedule errors begins in mid-August. Students receive their schedules by mail during the summer, and those with problematic schedules are expected to contact the school, meet with a counselor, and resolve the problems.

Although the time allocated in August for resolving such problems is limited, in a normal year most students have their schedule conflicts resolved before the school year begins. For example, in 2001-2002, only 47 returning students (approximately four percent of the returning student body) had schedule conflicts on the first day of school. Most of these 47 students had not attempted to resolve their schedule problems during the summer. Some of these students had not been able to schedule a time to meet with a counselor, due to a lack of time on the counselor's part or due to student summer employment schedules. A few were students who had met with a counselor without reaching a final resolution of the scheduling problems.

In addition to schedule changes made in the summer months, River High School allows students to request voluntary changes in their schedules during the first two weeks of the semester. During this time, counselors also create schedules for transfer students, ensure that twelfth grade students will meet graduation requirements, reassign students who failed one or more courses the previous spring, and resolve remaining schedule conflicts. Resolving any scheduling problem often involves dropping a course from the student's schedule, and almost invariably requires adding the student to a new course or moving the student to a different section.

Preliminary observations were conducted at River High School during the 1997-1998 school year. Our observations indicated that approximately 30 percent of River High School students changed their schedules after school started. The counselors judged that to be a typical year. Approximately two-thirds of these changes were student initiated, while most of the remainder were due to unresolved problems and circumstances. These problems included student schedule conflicts and preregistration errors, as well as an unexpected teacher change and the need to balance the size of some class sections.

These schedule changes led to a seemingly significant amount of missed class time for some students, regardless of the reason for the change. Most changes were made by a counselor who met with the student during the school day. This caused the student to miss class during the time required to change their schedule. For students changing sections of a class, the amount of lost time was usually one class period or less. Much more instructional time was lost by those students adding a new course during the first two weeks of the semester. Until the new course was added to the student's schedule, that student missed all of the classes for that course. Several students did not add their new course until the end of the second week of classes, and thus missed approximately 10 percent of the time the class was scheduled to meet that semester.

The steps in this scheduling process are typical for American high schools (DeLany, 1991). As previously noted, 30 percent of students changed schedules during our preliminary observations, which was typical for this school. For some schools in the U.S., this would be considered a relatively small number of schedule changes (see, for example, Pallas, Natriello, & Riehl, 1993). But by comparison with the ideal of all students having a complete schedule on the first day of school, the number of students missing instructional time at this school because of schedule changes could have been significantly reduced.

Theoretically, most of these schedule changes during the school year could have been avoided. Counselors might have done additional checks of students' preregistrations in the spring, continued revision of the master schedule until there were fewer schedule conflicts, and/or allocated more time in mid-August to make schedule corrections. The school could have made efforts to contact students who did not come to school to resolve schedule conflicts. Most effectively, the school could have required that student-initiated schedule changes be requested, and the revised schedules completed, before the start of the school year.

A combination of such practices could greatly reduce the number of schedule changes during the school year. A few schedule changes during the year would still be necessary, but most schedule changes that occurred during the school year in our preliminary observations could have been eliminated. However, this would require increasing the amount of time counselors spent on scheduling, at some cost. Whether that cost is justified by improved student learning is not known.

Non-Normal Errors and the Scheduling Process

The scheduling process for River High School allows for some schedule changes early in the school year. Since student-initiated schedule changes are generally permitted, and because this is known to the students, the process encourages schedule changes early in the school year. What is not apparent is that the process may fail, and fixing this failure may result in a large number of schedule changes.

We collected data on all schedule changes during the 1999-2000 school year, beginning at the start of the school year. As it turned out, a very large number of schedule changes occurred during the year. On the first day of school, half the students still had errors in their schedules, even after the counselors had spent the usual time making corrections in mid-August. Most of these students had schedules with a single error, either a schedule conflict between two courses or a course that was missing from their schedule. However, at least one student had only one of eight class periods accurately scheduled.

This large number of scheduling errors arose during the normal scheduling process. The school and school district did not maintain sufficient historical documentation to allow us to definitively identify the cause of the problem, and for our arguments, the exact cause is not important. What is clear is that the error was caused by school personnel. Furthermore, the problem was not noticed and identified as a significant problem before the school year began. The head counselor at River High School was in the best position to identify the problem, but a number of school personnel had access to the data and either did not notice the problem or assumed that the situation was under control.

As a result, the large number of scheduling errors on the first day of school was unexpected by the school and the counselors. Various *ad hoc* procedures were implemented, including sending students with scheduling errors to the gym where corrections were made. A large room was necessary because the counselors office could not hold more than a dozen students, and at the start of the year, every class period had over a hundred students with schedule errors. Other procedures included obtaining voluntary assistance from several retired counselors. Most importantly, the time period during which schedule changes were made was extended. Error corrections continued through the fourth week of school and student requests for schedule changes were handled through the sixth week of school. These corrections and changes normally are completed by the end of the second week of school. Throughout this time, teachers attempted to continue teaching. Many students attempted to continue learning, although some students took advantage of what they saw as an extended vacation.

The first two to three weeks of the school year were chaotic. Teachers wondered how this large

number of schedule errors had happened and why counselors could not correct student schedules more quickly. Counselors wondered why teachers were not more helpful in resolving scheduling errors. Student discipline declined with the large number of students moving to and from the gym every class period.

Ultimately, many students with correct schedules on the first day of the school had their schedules changed as well. Due to the number of students with incomplete schedules, the master schedule was revised extensively early in the year, and slightly revised on two subsequent occasions. As a result, 80 percent of all River High School students experienced a schedule change after the start of the school year. Changes made to the master schedule occurred overnight or during a weekend, which meant students might arrive at what had been their first class of the day, only to be given a new schedule.

From school records and through our observations, we are able to estimate the amount of class time missed by every student to within one-half of a class period. These estimates contain some error, of course, since we can identify the class period during which the student and counselor met, but cannot say exactly when they met during that period, or how long the student took to return to class after the meeting.

Given the large numbers of students who experienced some schedule change, surprisingly few students missed class time as a result of these schedule changes. Table 1 shows the distribution of class periods missed through the first four weeks of the school year for courses in one department, using the Department of Social Science as an example. The distribution of class periods missed for other academic classes follow a similar pattern, although English and Mathematics schedule changes were completed earlier in the semester. The table is grouped by weeks: River High School was following a block schedule, with 90 minute classes meeting every other day. Thus, in any week, some classes met three times and some classes met two times, so 2.5 class periods is the average "class week."

Periods		N	%
	-1.5	3	0.5%
	-1.0	13	2.0%
	-0.5		
	0.0	498	77.0%
Week 1			
	0.5	47	7.3%
	1.0	17	2.6%
	1.5	13	2.0%
	2.0	6	0.9%
	2.5	20	3.1%
Week 2			
	3.0	6	0.9%
	3.5	1	0.2%
	4.0	7	1.1%
	4.5	4	0.6%
	5.0	1	0.2%
Week 3			
	5.5	2	0.3%
	6.0		
	6.5	1	0.2%
	7.0		
	7.5		
Week 4			
	8.0	2	0.3%
	8.5	1	0.2%
	9.0	1	0.2%
	9.5	1	0.2%
	10.0	2	0.3%
Total Students		647	100.0%

Table 1: Class Periods Missed Due to Schedule Changes for Social Science Classes

Approximately 40% of the students in River High School changed their Social Science course or section (results not shown), but as can be seen in Table 1, 77% of students who took a Social Science class did not miss any class time due to schedule changes. A number of these schedule changes were made at night or over the weekend by counselors, and thus resulted in no loss of class time to the student. Also, some changes were made during the day, but students met with counselors during some period other than Social Science class. Obviously,

those students missed some class time, but not time from their Social Science class.

Due to block scheduling, some students who changed their Social Science class experienced an extra period of class. This occurred as follows: Students changed class on a day when they had already attended their Social Science class, and were put in a different section of their Social Science class that met the following day. Thus, they attended their Social Science class two days in a row, rather than every other day. In fact, due to an irregularity in the school year schedule, students whose schedules were changed over one particular weekend in mid-September could have experienced up to two extra days in a class. Because Table 1 shows class periods missed, students who experienced schedule changes that gave them extra classes are indicated by negative numbers in the table, since extra class periods are the opposite of periods missed. Thus, the table shows that 2.5% of all students attended at least one extra Social Science class because their schedule changed.

Of students who missed any class time, most missed less than a week of class, and most of the remaining students missed less than two weeks of class. Only a few students missed as much as four weeks of class. By some comparisons, this is not a great deal of time to be absent from class. For example, in any semester at this school, some students are absent because of health problems or truancy for more than four weeks of class.

However, the missed classes due to schedule changes are the direct result of an error in the school's scheduling process, not a result of individual student behavior. Furthermore, no policy or practice existed to detect or resolve the error prior to the beginning of the school year. In effect, the school randomly selected a large number of students and removed them from class for up to 20 percent of their class time for that semester.

The fact that such scheduling errors could occur and remain undetected and unresolved illustrates a casual attitude toward a scarce resource. Class time is limited, yet nothing prevented it from being wasted by scheduling errors and corrections. Our contention is supported by the fact that no new policies or practices were implemented as part of the scheduling process for the next year. Certainly, the counselors took greater pains and were more aware of scheduling and scheduling errors. But the basic procedures were unchanged, leaving the potential for a similar problem to occur at some point in the future.

Analyses

We now analyze the effect of class time missed due to schedule changes on student achievement. Our unit of analysis is student grade, and is based on students' first semester grades in their academic classes. Each student received grades in two to five academic classes, and after removing cases due to missing data, we analyze 3,110 grades.

To control for differences in teacher effectiveness, grade distribution, classroom cultures, class-specific disruptions, and a variety of other factors, we subtract the class mean grade from the student's grade. Thus, our dependent variable is a measure of the student's performance relative to the performance of his or her classmates, all of whom experienced the same teacher, instruction, disruptions, and grading practices. We make these calculations using the usual four point scale (A = 4, B = 3, etc.). Thus, a student who received an "A" in a class where the average grade for the class was a "B" would have a score of 1 on our measure. A student with a score of -0.5 would have received a semester grade half a letter grade lower than the class mean.

We control for student demographic factors, including sex, race, age, year in school, and whether the student received a free or reduced-price lunch. Student ability is controlled using the student's composite test score on a statewide test. The interactions of test score with year in school are included to control for test differences and for the length of time since students were tested. Finally, student absences are included in our model both as an indicator of student engagement and to control for class time missed by that individual student unrelated to schedule changes.

We analyze all 3,110 academic course grades simultaneously. Because there are only 736 stu-

dents, we expect each of the two to five grades generated by a student to be correlated due to unmeasured student factors. To control for these unmeasured factors, we use a hierarchical linear model. In addition, the grade distribution in Foreign Language courses was found to be significantly different from the grade distribution in other courses, and we control for this difference using a dummy variable for these classes.

The results of the hierarchical analysis are shown in Table 2. We would expect that the more class time the student missed due to schedule changes, the poorer his or her performance should be, relative to the rest of the class. However, the results show no effect of class time missed due to schedule changes (b = .00). Nor does this effect of zero vary significantly when it is allowed to vary by department (Mathematics, English, Science, Social Studies, and Foreign Language; results not shown). That is, two otherwise comparable students, one of whom missed no classes because of schedule changes and one of whom missed four weeks of classes because of schedule changes (the maximum possible for scheduling errors caused by the school), are predicted to have the same grade.

An informative comparison is to examine the effect of student absences. Class time missed by students for individual reasons has a significant effect on their grades. For every day absent, the student is predicted to lose 0.13 points from his or her grade. That is, on average, a River High School student loses a full letter grade for every three weeks (7.5 class periods) he or she is absent because of illness, truancy, etc.

Level 1	N =	3110		
Level 2	N =	736		
			Level 1 Effects	
		Coeff.	s.e.	*p*
Periods without Instruction		0.00	0.01	0.98
Foreign Language Course = 1		-0.14	0.04	0.00
			Level 2 Effects	
		Coeff.	s.e.	*p*
B0 =				
	Female = 1	0.16	0.05	0.00
	Black = 1	-0.13	0.07	0.04
	Free Lunch = 1	0.01	0.06	0.94
	Age (years, centered by grade)	0.01	0.06	0.81
	Sophomore = 1	-0.43	0.19	0.03
	Junior = 1	-0.20	0.17	0.25
	Senior = 1	-0.47	0.18	0.01
	Total Test Composite/10	0.07	0.02	0.00
	Test Composite times Sophomore	0.05	0.03	0.06
	Test Composite times Junior	0.02	0.03	0.34
	Test Composite times Senior	0.06	0.03	0.02
	Missing Test Composite = 1	0.05	0.10	0.59
	Periods Absent	-0.13	0.01	0.00
	Constant	-0.22	0.14	0.11
	Likelihood = -4001.59			

Table 2: Hierarchical Linear Model Predicting Mean-Centered Grades

In this sense, the seemingly casual attitude of the school toward loss of class time for students who make schedule changes is supportable. Although the schedule errors caused by the school resulted in students missing class time, apparently these students did not suffer any ill effects to their academic achievement. Their grades were no lower than those of their fellow students.

SUMMARY AND CONCLUSIONS

Time is one of many limited school resources. In order to be effective, schools must not waste their resources. In this examination, we discussed one high school that wasted a large amount of class time. In addition, a great deal of staff time and energy was expended in correcting the scheduling problems.

This wasted time was an indirect result of school policies and practices. Although caused by an error, the practices in place to detect and resolve such errors were insufficient. Furthermore, school policies regularly allow schedule changes during the initial part of the school year. This may have encouraged the lack of resolution of the problem ahead of time. Simply knowing that "a large number" of schedule changes would be required was not, in itself, taken as a warning sign.

Seemingly, the wasted time due to schedule changes had no effect on student achievement. In that sense, students who were caught up in this problem did not seem to suffer academically for the school's error. Yet at a larger level, this finding is more troubling than reassuring. Should a student be able to miss a significant number of classes and not have it affect his or her grade? This seems unlikely.

It is more likely that teachers reacted to the chaos of the extensive schedule changes by spending more time on review of material. Early in the year, teachers often spend a large portion of class time reviewing material from previous years. Since teachers were well aware of the scheduling problems and changes, we suspect they spent a significantly greater amount of class time reviewing material early in the year to ensure that all students were exposed to this review. Unfortunately, our research plan did not have the budget or human subjects approval for interviews with individual teachers, therefore we could not pursue this question.

Yet if teachers spent more time in review, the effect of the scheduling errors was not simply on the students who experienced scheduling errors, but on the school as a whole. More time spent on review leaves less time for new material. If teachers spent more time in review so that the school's error did not unfairly handicap those students who missed class, they may have hurried through the new material, or failed to present all of the material for the semester.

This study was not designed to determine how teachers adapted in the face of a significant failure of the scheduling process. That teachers did adapt is clear, because those students affected by scheduling errors did not suffer academically, or at least did not suffer relative to their fellow students.

What this study did determine is that one standard school process, conducted annually, always wastes some class time, and has the potential to waste large amounts of class time. This wasted time is a part of the school's standard policies and practices. Even after the failure of the system, additional checks were not put in place to alert the school to future problems. Elsewhere, Hallinan (2003) has addressed this issue in terms of Perrow's (1983) "normal accidents." Are there other school policies or procedures in place which might lead to similar accidents? Further research is needed to discover which policies and practices regularly waste valuable school time, and whether this negatively impacts student learning.

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