The Effect of Block Scheduling on Middle School Students' Mathematics Achievement

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To address the nation's ongoing interest in student achievement, some researchers have focused on the effect of block scheduling—a model in which students take fewer classes for longer periods of time. Although block scheduling has demonstrated its viability in high schools, little research has explored its effect at the middle level. Because the middle level years are often marked by a decline in student achievement, particularly during the transitional year when students move from elementary school to sixth grade, the current study was conducted. Results revealed significant increases in the mathematics achievement scores of sixth-grade students' enrolled in five middle level schools that transitioned from traditional to block schedules. Characteristics of block scheduling that may have accounted for these outcomes and recommendations for future research are discussed.

As student achievement gains momentum as a national priority, the amount of time used for instruction is often a focus of educators' interest. In recent years, many schools in the United States have modified class length (Canady & Rettig, 1995a). Some educators suggest that block scheduling, a model that allows students to take fewer classes for longer periods of time, enhances the possibility of uninterrupted class time and improves student achievement (Bevevino, Snodgrass, Adams, & Dengel, 1998; Cobb, Abate, & Baker, 1999; Queen, 2003; Shortt & Thayer, 1999). Schools in many parts of the country are experimenting with block scheduling as a means to enhance student performance. As the national emphasis on academic achievement grows, teachers, administrators, and many parents seek verification that block scheduling results in positive student outcomes.

At the secondary level, block scheduling has been associated with positive school climates, fewer discipline problems, increases in student participation, positive teacher and student perceptions of the daily schedule, and enhanced student achievement (Guskey & Kifer, 1995; Queen, 2000; Queen, Algozzine, & Eaddy, 1997; Wronkovich, Hess, & Robinson, 1997). Although considerable evidence exists to suggest the viability of block scheduling in high schools (Cawelti, 1994; Canady & Rettig, 1995b; Queen, Algozzine, & Isenhour, 1999),

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little research addresses block scheduling at middle level schools. Because the middle level years are often marked by a decline in student achievement, particularly during the transitional year when students move from elementary school to sixth grade (Eccles, Lord, & Midgley, 1991; Freshcorn, 2000), investigations of the effect of block scheduling in middle level schools is needed.

In the United States, middle level schools with traditional and block schedules have several similarities. First, they generally include grades 6–8. Second, in schools with either type of schedules, educators strive to: (a) develop a school climate of caring, respect, tolerance, and inclusion; (b) engage each student in appropriate but challenging instruction; and (c) have teachers who understand students' individual needs and who act to meet those needs (Mizell, 2002). Third, educators in middle level schools with traditional and block scheduling attempt to incorporate programming concepts that are aligned with the social, biological, cognitive development, and achievement needs of early adolescents. These programming concepts include interdisciplinary teaming/blocked classes, advisories, exploratory curriculum, developmentally appropriate teaching strategies, and a core curriculum (Alexander & George, 1981; National Middle School Association, 1995).

However, middle level schools with traditional and block schedules also differ in significant ways. For example, in schools with traditional schedules, a student's typical day consists of several different classes, an advisory period, and lunch—all in different locations within in a 61/2-hour time period. In this environment, students normally encounter six to seven different teachers, a disjointed curriculum, several sets of class rules, multiple homework assignments, and numerous books. To address required content, teachers often rely extensively on lectures to expose students to large amounts of information in 40- to 45-minute periods (Carroll, 1990; Queen, 2003). Comparatively, in middle level schools with block schedules, students engage in as few as five classes a day, allowing for more time per class. Classes are taught on a yearly or semester basis and, in most cases, teachers teach four or five periods per day. Teachers have the opportunity to use teaching strategies (e.g., cooperative learning, exploration, concept attainment, inquiry, case study, roleplaying, and simulations) that are difficult to implement during the shorter periods characteristic of traditional schedules (Canady & Rettig, 1995a). In addition, researchers have found that block schedules tend to result in fewer student discipline problems while providing more time for one-to-one interactions between students and teachers (Queen, 2003; Shortt & Thayer, 1999).

Because the core curriculum of nearly all middle level schools includes mathematics, knowledge of the effect of block scheduling is particularly important in this area (Kramer, 1997; Queen & Isenhour, 1998). And because sixth grade is particularly difficult for students who must adjust emotionally and academically to their new school environment (Alspaugh, 1998; Eccles et al., 1991; Queen, Akos, & Lineberry, in press), the purpose of the this study was to explore the effect of block scheduling on the mathematics achievement scores of sixth-grade students.

Method

Participants

Approximately 8,737 sixth-grade students in five middle level schools in a suburban/semi-rural county school district in the southeastern part of the United States participated in this study. The average age of participants was 12.7 years. The average daily enrollments of the five schools ranged from 821 to 1,266, with a mean (1,048) slightly larger than the district average (1,024). The schools were diverse. Although most students in four of the schools were White (60%, 79%, 91%, and 92%), one school's majority student population was Black (49%). A significant Black population (30%) also existed in the school that was 60% White. The predominantly Black school also had a significant Latino population (25%). Whereas three schools had percentages of students receiving free or reduced-price meals (3%, 15%, and 21%) that were below the district average (26%), the other two schools had significantly higher percentages of students receiving free or reduced-price meals (46% and 60%). Percentages of academically or intellectually gifted students ranged from a low of 8% to a high of 23% across the five schools. The percentages of students with disabilities ranged from 6% to 18%, compared to a district average of 12%.

The quantity of teachers in each of the five schools ranged from 54 to 73. Three of the five schools had two or more National Board Certified teachers, whereas two schools had no National Board Certified teachers. In four of the five schools, between 63% and 72% of the teachers were fully licensed; however, in the fifth school, 88% of the teachers were fully licensed. The percentages of teachers with advanced degrees ranged from a low of 16% to a high of 39%. Although relatively proportional numbers of teachers in each of the five schools were novice and experienced, teacher turnover rates ranged from 14% to 28%, compared to the district average of 17%. The enrollment and demographic data of students and teachers in the five schools and the district are summarized in Tables 1 and 2.

Procedures

For the first 3 of the 6 academic years examined in this study, courses in each of the five middle level schools were taught using traditional schedules. These schedules were characterized by fragmented 50- to 55-minute class periods, complete reshuffling of students between each period, and students assigned almost exclusively to classes with others thought to have similar academic abilities. On a typical day, most students attended six or seven different classes

School	Average Daily Enrollment	% White	% Black	% Latino	% Other	% Eligible	% Free/ Reduced Lunch	% Academically/ Intellectually Gifted	% Students With Disabilities
A	891	23	49	25	3		60	8	18
В	821	60	30	8	2		46	11	14
С	1,116	92	3	2	3		3	23	6
D	1,147	91	6	2	1		15	19	12
E	1,266	79	12	6	3		21	13	15
Sample averag	e 1,048	72	18	8	2		26	15	13
District averag	e 1,024	74	16	8	2		26	12	12

Table 1. Average Daily Enrollments and Demographics of Sample Schools and District

Table 2. Characteristics of Teachers in Sample Schools and District

	Total No.	No. With Nat'l Board	% Fully	% With Advanced	Years of Teaching Experience			% Teacher Turnover	
School	of Teachers	Certification	Licensed	Degrees	0–3	4–10	10+	Rate	
A	59	0	63	39	32	29	39	22	
В	54	2	70	22	30	30	41	15	
С	64	4	88	30	23	16	51	14	
D	64	5	72	27	25	34	41	16	
E	73	0	64	16	37	27	36	28	
Sample average	e 63	2	71	26	29	27	42	19	
District average	e 62	2	73	27	27	28	46	17	

taught by six or seven different teachers. Students almost never had more than 4 minutes between periods to access their lockers or go to the restroom.

For the last 3 of the 6 academic years examined in this study, courses in each of the five middle level schools were taught using one or more forms of block scheduling—4 x 4, alternate day, or fan block (Queen, 2003). In the 4 x 4 schedule, classes were approximately 90-minutes long. Teachers taught three classes each semester and used the fourth period of each day for individual or team planning. Students enrolled in as many as eight different classes each academic year (i.e., four classes per semester). Classes using the alternate day schedule were 90-minutes on alternating days, resulting in each class having met five times over a 2-week period. Days were designated as either "A" or "B." Teachers taught three classes each day and used the fourth period for planning. Students enrolled in six to eight classes per year. Classes in the fan block schedule met either every day or every other day and in combination for both extended and shortened blocks of time.

Classes were taught on a yearly or semester basis. Teachers taught four or five periods a day and used the remaining time for individual and team planning. Students enrolled in five to six classes each year.

At the end of each academic year, students' academic achievement was assessed using state-mandated, criterion-referenced, end-of-grade tests in mathematics. These tests required students to answer questions related to objectives established by the state's Standard Course of Study, an outline of the competencies and standards required for 6th graders in mathematics courses (North Carolina Department of Public Instruction, 2000).

The sixth-grade mathematics test was comprised of two parts: a computations section and an applications section. The computations section consisted of 12 problems designed to assess a student's ability to compute and solve problems without a calculator. The applications section consisted of 68 problems involving real-world situations that sixth-grade students may have encountered. The applications section was designed to assess a student's ability to use a calculator, ruler, or protractor while applying mathematical principles, solving problems, and explaining mathematical processes.

In collaboration with the L.L. Thurstone Psychometric Laboratory, the North Carolina Department of Public Instruction (2000) created a developmental scale score to measure and reflect growth in students' mathematics skills and knowledge with this end-of-grade test. The decision was made that the developmental scale score should range from 100 to 200. A student's expected score would be 155.88 with a standard deviation of 10.25. With this standard deviation, one point on the scale closely corresponded to the .10 standard deviation that is typical of most achievement tests. Each student's final score was determined by calculating the number of items answered correctly by the student on the test's two sections (i.e., computations and applications) and then converting that sum to a developmental scale score. This calculation considered both the easier-to-most-difficult items used across the various forms of the test and the different forms of the test to compute comparable scale scores for each student who took the test. Six equivalent forms of the test were created and administered. Of special significance to the comparison of student scores across time was the equivalence of the test forms. All six forms were equated to the mean derived from the latent proficiency scaling of the tests (North Carolina Department of Public Instruction, 1996). The differences between the mean scores across the forms were at or near zero and were always less than the standard error of measurement for the test.

The reliability and validity of the mathematics end-of-grade tests were well established (Sanford, 1996). Regarding internal consistency reliability, coefficient alphas for the tests ranged from .90 to .94. Establishing the tests' content validity, all items were written and reviewed by the state's teachers and were aligned with the state's Standard Course of Study.

In addition to analyzing the sixth graders' end-of-grade mathematics test scores, researchers interviewed selected teachers and reviewed school records in an attempt to identify variables associated with block scheduling that may have affected the sixth graders' mathematics achievement.

Results

Means, standard deviations, and sample sizes of mathematics achievement by school (i.e., A, B, C, D, and E), by academic year (i.e., 1994–95, 1995–96, 1996–97, 1997–98, 1998–99, and 1999–2000), and by schedule (i.e., nonblock and block) are presented in Table 3.

At Schools A, C, D, and E, as compared to the schools' 1996–97 mathematics achievement mean, no significant differences were revealed in the first year of transition to block scheduling (i.e., 1997–98). However, during the second and third years after implementing block scheduling, students' scores demonstrated a significant upward trend in mathematics achievement as evidenced by the difference in achievement means for 1998–99 and 1999–2000. The effect sizes of the differences between 1996–97 and 1998–99 for Schools A, C, D, and E were .21, .58, .45, and .40, respectively. The effect sizes of the differences between 1996–98 and 1999–2000 for Schools A, C, D, and E were .35, .45, .73, and .51, respectively.

At School B, as compared to the school's 1996–97 mathematics achievement mean, significant differences existed for all 3 years after implementing block scheduling. The effect sizes of these differences in 1997–98, 1998–99, and 1999–2000 were .36, .59, and .46, respectively.

Figure 1 illustrates the sixth-grade mathematics achievement score averages at the five middle level schools during the 3 years that preceded block scheduling and the 3 years that followed block scheduling. As revealed by the figure, scores at all schools rose between the 1996–97 and 1997–98 school years, and continued to rise during the succeeding two school years.

Discussion

In all five middle level schools, students achieved better in mathematics after the school transitioned from traditional to block scheduling between the 1996–97 and 1997–98 academic years. This finding is important, particularly in light of the fact that the schools' characteristics varied extensively and that no other significant changes occurred at the schools during this time period that could account for the improvement in mathematics learning. For example, with respect to the students, the socioeconomic backgrounds, ethnicities, number of free and reduced-price meal recipients, and quantity and types of children with exceptionalities varied widely among the schools. With respect to the teachers and administrators, the experience levels, educational backgrounds, and licensure sources varied just as greatly. Yet despite these differences,

			Non-Block			Block	
School		1994–95	1995–96	1996–97	1997–98	1998–99	1999–2000
A	Mean	158.70	160.60	159.90	158.30	162.10 ^b	163.60 ^c
	SD	10.02	10.76	10.58	10.19	11.07	10.52
	п	240.00	244.00	242.00	256.00	250.00	266.00
В	Mean	157.50	157.90	156.40	160.30 ^a	162.80 ^b	161.40 ^C
	SD	10.17	10.37	10.84	10.90	10.36	10.14
	п	256.00	261.00	263.00	235.00	223.00	251.00
С	Mean	159.70	163.90	163.70	164.80	169.60 ^b	168.20 ^c
	SD	10.53	11.00	10.10	10.48	10.32	12.05
	п	289.00	281.00	273.00	327.00	284.00	310.00
D	Mean	163.80	163.60	164.00	166.00	168.50 ^b	171.20 ^c
	SD	9.29	9.70	9.93	9.69	9.76	8.86
	п	311.00	307.00	303.00	322.00	309.00	307.00
E	Mean	164.00	164.80	164.30	165.40	168.10 ^b	169.10 ^c
	SD	9.81	9.98	9.45	9.47	10.51	9.80
	п	387.00	381.00	390.00	397.00	255.00	317.00

 Table 3. Means, Standard Deviations, and Sample Sizes of Mathematics Achievement

 by School, Academic Year, and Schedule

^a Difference between 1996–97 and first-year block significant at the 0.01 level.

^b Difference between 1996–97 and second-year block significant at the 0.01 level.

^c Difference between 1996–97 and third-year block significant at the 0.01 level.



Figure 1. Effect of block schedule on sixth-grade mathematics achievement by	/
middle school.	

students in all environments prospered academically when exposed to block scheduling. It is important to address possible reasons for this outcome.

First, block scheduling allows students to take more classes, thereby broadening the scope of their course selection. With a block schedule, students are often able to take more electives than under a traditional schedule. In this study, more students took more and higher-level mathematics courses as a result of the additional opportunities afforded by the block schedule. Furthermore, as more students completed AP classes, their grades tended to improve.

Second, block scheduling affords longer class periods. Longer class periods may allow more time for interactive instruction using varied teaching strategies, such as cooperative learning, inquiry method, group discussion, concept development, simulations, and seminars. In the current study, many teachers stated that they tried new approaches to teaching after block scheduling began in their schools. Several teachers suggested that student learning was enhanced as a result of their new instructional practices in the classroom.

Third, in block schedules, students are less likely to show disruptive behavior and more likely to focus on their academic work because of reduced time in changing classes. In the current study, students spent an average of 10 fewer minutes each day changing classes when exposed to block scheduling as opposed to their former traditional schedules. On average, the frequency of office referrals and disciplinary actions lessened when schools began block scheduling.

Fourth, block scheduling offers the potential to alter curriculum delivery to adequately meet the needs of all students in a regular classroom. Increased time per class provides teachers more opportunities to individualize instruction and students more chances to receive personal attention. In this study, students spent up to 90 minutes in each classroom being taught by a teacher who had the opportunity to know the specific learning needs of each student.

Finally, block scheduling affords teachers more time to plan and prepare for classes. In this study, after conversion to block scheduling, teachers spent less time attending to attendance rosters, report cards, and other administrative matters, thereby giving them additional opportunities for planning instruction.

Conclusions and Recommendations

Although block scheduling has been associated with enhanced student achievement at the high school level, few studies to date have addressed the effect of block scheduling in middle level schools. Because the middle level years are often marked by a decline in student achievement, especially when students transition from elementary school to sixth grade, investigations of the effect of block scheduling in middle level schools have been needed. The current study discovered marked increases in sixth-grade students' mathematics achievement after the students' schools transitioned to block scheduling. Although this study did not focus on outcomes other than mathematics achievement, the increase in mathematics achievement may have been due to the inherent characteristics of block scheduling.

As our nation's schools strive to continue to respond to the mandates of the No Child Left Behind (2002) legislation, the effect on student achievement of block scheduling should continue to receive research attention. Future investigations should attempt to replicate this study's findings by examining the effect of block scheduling on achievement in other middle level schools, to include inner city, suburban, urban, and rural schools. In addition, block scheduling's effect in content areas other than mathematics should be explored. Finally, future research efforts should attempt to delineate the specific features within block scheduling (e.g., students taking more courses, spending longer amounts of time in each class, spending less time transitioning between classes, and teachers having more opportunities to know their students, to individualize instruction, and to prepare for classes) that contribute most significantly to gains in student achievement.

Although block scheduling is not a panacea for all issues surrounding student achievement in our schools, its promise as a powerful contributor to student learning has been demonstrated and should continue to be explored. While researchers work to more clearly delineate the characteristics of block scheduling that most directly effect student achievement, middle level educators should consider the positive effect revealed in this study of block scheduling on sixth-grade students' mathematics achievement. **#**

References

- Alexander, W. M., & George, P. S. (1981). *The exemplary middle school*. New York: Holt, Rinehart, & Winston.
- Alspaugh, J. W. (1998). Achievement loss associated with the transition to middle and high school. *Journal of Educational Research*, 92(1), 20–25.
- Bevevino, M. M., Snodgrass, D. M., Adams, K. M., & Dengel, J. A. (1998). An educator's guide to block scheduling: Decision making, curriculum design, and lesson planning strategies. Boston: Allyn and Bacon.
- Canady, R. L., & Rettig, M. D. (1995a). *Block scheduling: A catalyst for change in high schools.* Princeton, NJ: Eye on Education.
- Canady, R. L., & Rettig, M. D. (1995b). The power of innovative scheduling. *Educational Leadership*, 53(3), 4–10.
- Carroll, J. M. (1990). The Copernican plan: Restructuring the American high school. *Phi Delta Kappan*, 71(5), 358–365.

- Cawelti, G. (1994). *High school restructuring: A national study*. Arlington, VA: Educational Research Service.
- Cobb, R. B., Abate, S., & Baker, D. (1999). Effects on students of a 4 x 4 junior high school block scheduling program. *Education Policy Archives*, 7(3). Retrieved from http://epaa.asu.edu/epaa/v7n3.html
- Eccles, J. S., Lord, S., & Midgley, C. (1991). What are we doing to early adolescents? The impact of educational contexts on early adolescents. *American Journal of Education*, 89, 521–542.
- Freshcorn, E. L. (2000). School transition and students' academic growth in reading and mathematics. Unpublished doctoral dissertation, University of North Carolina at Charlotte.
- Guskey, T., & Kifer, E. (1995, April). *Evaluation of a high school block schedule restructuring program.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.
- Kramer, S. L. (1997). What we know about block scheduling and its effects on math instruction: Part I. *NASSP Bulletin*, *81*(586), 18–42.
- Mizell, H. (2002). What parents need to know about middle school reform. New York: Author. (ERIC Document Reproduction Service No. ED471909).
- National Middle School Association. (1995). *This we believe*. Columbus, OH: Author.
- No Child Left Behind Act of 2001 (H.R. 1), 107 Cong., 110 (2002) (enacted).
- North Carolina Department of Public Instruction. (1996). North Carolina end-of-grade tests: Reading comprehension and mathematics. (Tech. Rep. No. 1). Raleigh, NC: Author. (ERIC Document Reproduction Service No. ED406397).
- North Carolina Department of Public Instruction. (2000). *Standard course of study*. Raleigh, NC: Author.
- Queen, J. A. (2000). Block scheduling revisited. *Phi Delta Kappan, 83*(3), 214–222.
- Queen, J. A. (2003). *The block scheduling handbook*. Thousand Oaks, CA: Corwin.
- Queen, J. A., Akos, P., & Lineberry, C. (in press). *Successful student transition from elementary to middle school.* New York: Eye on Education.
- Queen, J. A., Algozzine, B., & Eaddy, M. (1997). The road we traveled: Scheduling in the 4 x 4 block. *NASSP Bulletin*, *81*(588), 88–99.
- Queen, J. A., Algozzine, B., & Isenhour, K. G. (1999). First year teachers and 4 x 4 block scheduling. *NASSP Bulletin, 83*(603), 100–103.

- Queen, J. A., & Isenhour, K. G. (1998). *The 4 x 4 block schedule*. Princeton, NJ: Eye on Education.
- Sanford, E. E. (1996). North Carolina end-of-grade tests (Tech. Rep.). Raleigh, NC: Department of Public Instruction, Office of Instructional and Accountability Services, Division of Accountability/Testing.
- Shortt, T. L., & Thayer, Y. V. (1999). *The complete handbook of block scheduling*. Bloomington, IN: Technos.
- Wronkovich, M., Hess, C. A., & Robinson, J. E. (1997). An objective look at math outcomes based on new research into block scheduling. NASSP Bulletin, 81(593), 32–41.

