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The Impact of Block Scheduling on Student Motivation and Classroom Practice in Mathematics

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Results are presented from a mixed-method investigation into the effects of Block Schedule on student self-efficacy, attitude, and instructional practices within the context of mathematics. Students exposed to block schedule showed no change in attitude toward mathematics, whereas those on a traditional schedule demonstrated a significant decrease. Students on block schedule also made significantly greater gains in self-efficacy. If reformed teacher practice is a goal of transitioning to block schedule, results point to a critical need for professional development.

Keywords: *block schedule; mathematics; self-efficacy; math attitudes; surveys; focus groups; high school; classroom observations*

Block scheduling has emerged as a trend in American secondary schools. Although the potential for block scheduling to increase student achievement and self-efficacy continues to fuel discussion around this trend (Payne & Jordan, 1996; Wronkovich, 1998), the lack of a clear empirical consensus in regard to these outcomes has left educators questioning the true merits of this intervention (Zepeda & Mayer, 2006). Indeed, the most common weaknesses reported within scholarly research on block scheduling include the omission of key contextual information, failure to adequately track changes in teacher behaviors, and a lack of clarity with regard to teachers' and students' positive views of the intervention (Zepeda & Mayer, 2006). This article outlines current literature with regard to block scheduling and describes a robust mixed-method investigation into the effects of an alternating block schedule model on student self-efficacy, attitude, and instructional practices within

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the context of mathematics. In addition to quantitative measures of student attitudes and beliefs, a series of qualitative methods, including classroom observations and focus group interviews, were included to address some of the shortcomings noted from previous research.

Recent Research on Block Scheduling

Block scheduling provides students with fewer classes each day, for longer periods of time. The most common reason cited for using a block schedule is a longer period of instruction, whereby teachers can delve more deeply into the content of a lesson and provide students with more authentic learning opportunities, such as laboratory experiences, cooperative group work, and project-based learning tasks. In theory, students in schools using block scheduling have time for additional elective courses and can earn more academic credits. Furthermore, teachers working within a block schedule use less time for administrative tasks such as taking attendance. To date, empirical evaluation results for block scheduling have been inconclusive (Griffin & Nicholson, 2002). Whereas some studies have indicated a positive effect for block scheduling on student achievement (Hughes, 2004), other studies focused on specific academic disciplines have shown small effects (Nichols, 2005) or in some cases, a decrease in student performance (Rice, Croniger, & Roellke, 2002). Correlational studies have demonstrated a positive relationship between overall grade point average, high school proficiency exam scores, college entrance exam scores, ability, citizenship, and achievement in specific academic domains (Trenta & Newman, 2002). However, the restraints of the quasi-experimental methods typically used in K-12 research environments make it difficult to assert any causal effects to block scheduling.

Although the relationship between block scheduling and achievement may be spurious, Hackman (2004) suggests that implementing a block schedule gives school leaders a perfect opportunity to question current pedagogical practices and affords teachers the opportunity to redefine their role in the classroom. Unfortunately, the lack of focus on the underlying issue of reformed teacher practice often conveys the misperception of block scheduling as an end rather than a means to an end. Provided that pedagogical changes do in fact take place, results consistently indicate enhanced morale, greater student satisfaction, and improved student-teacher relationships with block scheduling (Hackman, 2004; Hurley, 1997).

The impact of block scheduling on student perceptions of the learning environment and secondary achievement indicators is positive. Block schedule programs tend to produce a higher frequency of students who feel more academically focused, achieve honor roll status, successfully complete advanced placement courses, and exhibit a lower occurrence of failure (Evans, Tokarczyk, Rice, & McCray, 2002). However, the connection between latent variables within the context of block schedule and the kinds

of specific measures related to student achievement that school leaders typically use to make fiscal decisions are vague. For example, in a study of block scheduling effectiveness, Griffin and Nicholson (2002) write,

> There is strong evidence of prevalent feelings of self-efficacy among students at both schools [on block schedule]—the feeling that they are learning more and that they have more control over their learning, both stemming from the block schedule and the teaching/learning situations within the block. (p. 8)

Unfortunately, the same study yielded no significant increases in student performance and it is unclear whether the reported positive changes in student confidence for academic tasks are consistent across differing ability levels. While several threats to internal validity raise questions about the generalizability of the results, the conditions under which these changes in confidence occurred and the strength of their relationship to reformed pedagogy are not well-defined. Furthermore, the relationship between prior academic achievement and student attitude toward learning as a result of a block schedule has not been addressed.

Zepeda and Mayer (2006) conducted a recent review of 58 empirical studies on block scheduling and noted a majority of them to be lacking in their contextual descriptions, the research and analysis methods employed, the instruments used, and the stability of the data collected. As the authors note,

> From the lack of description within and across the studies of the groupings, it was clear that research focused primarily on smaller units within the schools, without much attention to examining change in light of the contexts in which the studies were conducted. (p. 159)

The review also suggests a need for more research on block scheduling in urban settings.

Student motivation for learning could be enhanced using the additional classroom time available in a block schedule and would serve as an important outcome related to student achievement. Self-efficacy is a key student motivational variable that addressed in previous research and would likely respond favorably to a change in the learning environment such as transitioning to block scheduling. Self-efficacy (Bandura, 1977, 1997), within the framework of social-cognitive theory, is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). The influence of perceived self-efficacy as a significant predictor of behavior is well-supported in the literature (Kennett & Keefer, 2006). Individuals with higher self-efficacy typically view successful task completion as highly dependent on effort and persistence; they often choose more challenging tasks because of their perceived benefits. Individuals with a lower self-efficacy may view increased effort as an indicator of lower ability and be drawn to the simplest tasks as a coping mechanism to avoid failure (Dweck, 1999). Self-efficacy serves as a proxy to the kinds of productive student behaviors that can

account for positive changes in achievement. Documenting positive changes in student self-efficacy as a result of block scheduling would identify an important variable supporting block scheduling as a means to an achievement end.

An explicit line of research to investigate a relationship between a transition to a block schedule and changes in self-efficacy relative to a particular subject (i.e., confidence in one's abilities in math or science) are all but absent from current scholarly literature. However, there have been several studies aimed at examining students' attitudes and beliefs toward the innovation itself that are worth mentioning. Wilson and Stokes (2000) found that students exposed to block scheduling as well as traditional academic scheduling found blocked courses significantly "more interesting." In addition, students seeking a general diploma believed block schedule to be a more effective method than those seeking advanced diplomas. These findings have also been corroborated by a decline in student test scores on Advanced Placement exams with students on block schedule (Gullatt, 2006). Wilson and Stokes (2000) also noted a strong, positive relationship between the number of varied instructional activities used in a typical class period and student attitudes toward the effectiveness of the innovation.

The results of a student survey administered to more than 400 high school graduates in Alabama also demonstrated positive attitudes toward block schedule (Liu & Dye, 1998). Most of the students felt that they had more learning time, additional opportunities to work with other students, and achieved higher grades. However, these same students did not notice any changes in teacher behavior, particularly with regard to the number of instructional activities infused into a class period. Furthermore, the study was conducted in a rural school district whereas the current study took place in a large, progressive city in the southwest United States.

Another study did note that students who were exposed to a block schedule in high school felt adequately prepared for college courses in math, science, and foreign language (Salvaterra, Lare, Gnall, & Adams, 1999). Opinions were collected via a survey mailed to recent graduates from two unique high schools after completing their first semester of undergraduate courses. Ironically, these students had difficulty "going back" to a 50-min class period, where a majority of their course work and opportunities had to take place outside of scheduled class times. Once again, this study noted that students felt that their learning was positively affected when teachers implemented a variety of instructional approaches into their daily lessons, particularly student-centered activities.

Purpose of the Current Study

In an effort to enhance student achievement, a large urban school district in the southwestern United States appropriated additional staffing units to implement block scheduling in 13 of its 35 comprehensive high schools for the 2005-2006 school year. As a result of a recent adoption of more stringent standards for earning a high school

diploma, mathematics achievement was identified as a district-wide goal. Students who fail the State High School Proficiency Exam in Mathematics (HSPEM) earn a certificate of attendance in lieu of a high school diploma. The HSPEM, which was recently modified considerably by the State Department of Education, now includes questions that require mastery of algebra and geometry, concepts previously not assessed on the exam. In addition, the question stems have been restructured and now require students to demonstrate problem solving and procedural knowledge as opposed to the factual knowledge and algorithmic expectations of the past. This high-stakes requirement has placed tremendous pressure on schools and teachers to improve the teaching and learning of mathematics.

Block scheduling was defined as an alternative scheduling format for high school students, where they enroll in eight courses and each course meets every other day for 85 min (four different courses per day). The district refers to this form of scheduling as an alternating block schedule model and is juxtaposed to a traditional schedule that allows for six, 55-min courses meeting every day. Block scheduling had been piloted in two high schools over the past several years in this district. However, no formal study or comparisons were made to investigate if the innovation produced positive trends in student achievement. While the superintendent was eager to expand the program into more high schools, the Board of School Trustees requested that a data collection vehicle be put in place along with the program's expansion to determine if in fact student achievement did increase as a result and to identify best practices for implementation. The superintendent agreed and commissioned a block schedule research committee to design and implement a 3-year study. Members of the committee included regional assistant superintendents (the district was divided into five geographic regions in 2000 to provide more focused and localized leadership), principals, district research analysts, university faculty, and graduate students from a local university.

The school district commissioning this study was most concerned with changes in student achievement and performance on state mandated tests required for graduation. Other lines of research such as self-efficacy, student perceptions, and teacher behaviors emerged from the review of literature. Because innovations such as this often take years to produce anticipated gains in student achievement, self-efficacy was identified as a mediating variable with the hope that student gains could eventually translate into higher graduation rates, test scores, and enrollment into post-secondary education.

As noted by Wilson and Stokes (2000), as well as Salvaterra et al. (1999), teacher behavior is a key component of realizing positive outcomes related to the implementation of block schedule. The committee determined that classroom observations were needed to determine if changes in teaching style and pedagogy had occured as a result of the new schedule. As prior research demonstrates (Hackman, 2004; Hurley, 1997), a paradigm shift in regard to the role of the classroom teacher is essential to realizing other notable changes in student efficacy and achievement.

Therefore, the observations were added to the study to closely monitor fidelity in program implementation.

A criticism of prior research made by Zedepa and Mayer (2006) was that even when students and teachers indicated positive appraisals of block schedule, their reasons were unknown. A series of formal focus group interviews was included in the study to give students the opportunity to expound on both the strengths and perceived weaknesses of block schedule. It was hoped that this information could inform future implementation as the district plans to expand the number of schools utilizing block schedule provided that there exists strong empirical evidence to support the additional costs of the innovation.

In order to gauge a more authentic comparison of the two schedule types, a sample of students with exposure to both schedules was desired (traditional and block). Therefore, it was decided by the committee that a sample of Grade 10 students from schools' new to block schedule for the 2005-2006 school year would be ideal. Commensurate with this goal, three treatment schools new to block schedule were invited to participate in the research project. Samples from these schools were primarily made up of students who were on a traditional schedule for 2004-2005 (while in Grade 9) and on a block schedule for 2005-2006 (while in Grade 10).

Method

The research reported here, as a component of a larger evaluation project on block scheduling, sought to investigate the effects of an alternating block schedule model on student self-efficacy, attitude, and instructional practices within the context of mathematics. Data were collected over an entire academic year with pretesting in September and posttesting in May.

A mixed-method quasi-experimental design was used to understand the impact of an alternating block schedule model on student self-efficacy, attitude, and classroom practice in mathematics. Using a sample of convenience, results were analyzed by course to investigate the effects of block scheduling with students of varying ability and differing exposures to academic rigor. The following research questions guided the study:

1. How is student self-efficacy for mathematics affected by an alternating block schedule model?
2. Do students learning mathematics in an Alternating Block Schedule Model develop more positive attitudes toward school and themselves as learners compared with students exposed to a traditional schedule?
3. Are changes in student self-efficacy and attitude toward mathematics the result of an interaction between learning in an alternating block schedule model and ethnicity* or course rigor?

Table 1
Total School Demographics by Ethnicity and School

Ethnicity	School A	School B	School C	School D (Comparison)
Caucasian	955 (29.9%)	1400 (47.1%)	1131(47.5%)	376 (11.9%)
Black	1035 (32.4%)	559 (18.8%)	267 (11.2%)	600 (19%)
Hispanic	898 (28.1%)	740 (24.9%)	498 (20.9%)	2026 (64.1%)
Native American	16 (0.5%)	36 (1.2%)	12 (0.5%)	35 (1.1%)
Asian/Pacific Islander	294 (9.2%)	238 (8%)	471 (19.8%)	126 (4%)
Total	3198	2973	2379	3163

* Additional analyses were conducted with ethnicity introduced as a second potential mediating variable to investigate the effects of an otherwise unbalanced sample. Specifically, the ethnic makeup of the comparison school was significantly different than that of the three treatment schools.

4. How does the learning environment of a mathematics classroom differ in a school using an alternating block schedule model?

Participants

Three treatment schools and one comparison school were selected to participate in the study. All four schools have diverse student populations and committed school leadership teams. The ethnicity of students at the schools ranged from 52% to 82% minority whereas total student enrollment for each school ranged from 2,379 to 3,198 (Table 1).

Each of the schools are fairly new (built within the past 10 years) and the layout of each building is identical. Two of the treatment schools were located in moderately affluent neighborhoods whereas the third treatment school and the comparison school were in lower socioeconomic areas of the city.

Site principals selected course sections of varying mathematical rigor (remedial, regular, and accelerated), which were primarily made up of Grade 10 students. To maximize validity, similar courses were selected from each school. In order to pinpoint the more immediate effects of block scheduling on changes in student beliefs and attitude, students in the 10th grade were identified as preferred participants. In most cases, these students were new to block scheduling and had attended a comprehensive high school within the district on a traditional schedule in the past. Therefore, the effects of the new innovation might be established. Finally, it was hypothesized that students in 10th grade were not overly attached to the prior (traditional) schedule and therefore most willing to accept the new innovation as one that could assist them academically. A concerted effort was made to target courses traditionally consisting primarily of 10th grade students, such as geometry and algebra (Tables 2 & 3).

Table 2
Subject Demographics by Mathematics Course and School

Course	Total	School A	School B	School C	School D (Comparison)
Algebra IB (or equivalent)	67 (27.7%)	11 (17.7%)	13 (41.9%)	3 (12%)	40 (32.3%)
Geometry	129 (53.3%)	16 (25.8%)	18 (58.1%)	22 (88%)	73 (58.9%)
Geometry honors	45 (18.6%)	35 (56.5%)	0	0	10 (8.1%)
Nonresponse	1 (0.4%)	0	0	0	1 (0.8%)

Table 3
Subject Demographics by Year and School

Grade	Total	School A	School B	School C	School D (Comparison)
Freshman	65 (26.9%)	16 (25.8%)	6 (19.4%)	22 (88%)	43 (34.7%)
Sophomore	148 (61.2%)	39 (62.9%)	22 (71%)	3 (12%)	65 (52.4%)
Junior	19 (7.9%)	7 (11.3%)	3 (9.7%)	0	6 (4.8%)
Senior	2 (0.8%)	0	0	0	2 (1.6%)
5th year senior	1 (0.4%)	0	0	0	1 (0.8%)
Nonresponse	7 (2.9%)	0	0	0	7 (5.7%)

A preinterview exercise was conducted by the research team with each teacher to discuss the purpose of the study, the informed consent procedure, data collection, time line, and to establish trust (Kvale, 1983).

A total of 242 students from four schools provided youth assent as well as parental informed consent and participated in the study. The three treatment schools followed the alternating block schedule model whereas the comparison school remained on a traditional schedule. Participants had a mean age of 15 years and 28.1% were Caucasian. Of the 242 participants included in the study, 118 represent the *treatment group*, and the remaining 124 represent the *comparison group.* The ethnicity of the two groups was dissimilar, with the treatment group containing a higher percentage of Caucasian subjects (39.0% vs. 17.7%) and a lower percentage of Hispanic subjects (22.9% vs. 55.6%). See Table 4 for complete demographics of each school's sample.

Measures

Participants were administered a revised version of the Fennema-Sherman Attitude Scale (Fennema & Sherman, 1976a), pre-post to gauge changes in attitudes

Table 4
Subject Demographics by Ethnicity and School

Ethnicity	Total	School A	School B	School C	School D (Comparison)
Caucasian	68 (28.1%)	22 (35.5%)	16 (51.6%)	8 (32%)	22 (17.7%)
Black	42 (17.4%)	14 (22.6%)	4 (12.9%)	2 (8%)	22 (17.7%)
Hispanic	96 (39.7%)	16 (25.8%)	6 (19.4%)	5 (20%)	69 (55.6%)
Native American	3 (1.2%)	1 (1.6%)	1 (3.2%)	0	1 (0.8%)
Asian/Pacific Islander	29 (12.0%)	9 (14.5%)	3 (9.7%)	10 (40%)	7 (5.6%)
Nonresponse	4 (1.7%)	0	1 (3.2%)	0	3 (2.4%)

towards mathematics. Selected items from the Fennema-Sherman instrument provide subscales focused on five distinct student attitude factors about mathematics: success, effectance motivation, usefulness, teacher, and confidence. Clusters consist of 12 items for each subscale with 6 positively loaded items and 6 negatively loaded items. Negatively loaded items were reverse scored and item-grouping formulas were adopted from prior research to ensure maximum reliability and validity (Fenemma & Sherman, 1976b). A repeated measures analysis of variance (ANOVA) was planned with time as the within subjects factor (pre-post) and schedule as the between subjects factor (block vs. traditional).

A 12-item mathematics self-efficacy survey was constructed by the authors and administered pre-post to all participants. The self-efficacy instrument asked students to self-assess their confidence on a Likert-type scale related to answering 12 items taken from a previously released practice version of the HSPEM. Another repeated measures analysis of variance (ANOVA) was planned similar to that which was used for math attitude.

Four students were randomly selected per course level at each school (a total of 12 from each school) to participate in student focus group interviews. The goal of the focus group interviews was to make use of group interactions to gain a richer description of the phenomena (Fossey, Harvey, McDermott, & Davidson, 2002; see appendix). The lead researcher conducted each of the three focus group interviews. Focus group sessions were approximately 60 min in length and were recorded and later transcribed for thematic analysis. An open coding procedure was used to identify discussion points that corroborated and supported, or contradicted student responses from the surveys and field notes from the classroom observations. The coding categories were class activities, connections with teachers, attitude toward block schedule, balance of schedule, student attitude toward learning mathematics in block schedule, and learning.

Classroom observations were completed in a random sample of 9 of the 22 classrooms using a revised version of a formal classroom observation instrument (Estacion,

McMahon, Quint, Melamud, & Stephens, 2004). Five of these classrooms were observed twice (once in the winter and again in the spring), two were observed once in the winter, and the remaining two were observed once in the spring.

Analysis and Results

Paired sample *t* tests and repeated measures ANOVAs were conducted on the attitude and self-efficacy survey responses. Course rigor and ethnicity were also investigated as potential mediating variables. Because outcomes across the treatment seem to vary for different student subpopulations (such as advanced placement students), course rigor was deemed an important variable. Ethnicity was also examined to ensure that the disproportionate ethnic makeup of the comparison school did not produce any spurious relationships unrelated to the treatment. A chi-square test of significance was conducted to test for homogeneity of the ethnic makeup of the four schools. The results showed that the ethnic makeup from each of the treatment schools was significantly different than that of the comparison school $t_{(1,4)} = 21.53$, $p < .001$. Specifically, the comparison school had far fewer Caucasian students and far more Hispanic students compared with the three treatment schools. Although ethnicity was introduced as an additional blocking variable to ensure that trends in the data were not due to variations by ethnic group, the results should be interpreted cautiously as the climate of the comparison school is uniquely different than that of the three treatment schools.

Cronbach's alpha indices revealed acceptable parameters for both the pre- and post-administrations of the self-efficacy measure ($\alpha_{pre} = .86$, $\alpha_{post} = .83$) as well as the math attitude measure ($\alpha_{pre} = .94$, $\alpha_{post} = .96$). A repeated measures ANOVA yielded no significant changes in math attitude over time, $F(1, 240) = 0.518$, $p = .473$, $\eta^2 = .002$. However, the two groups were not statistically equivalent on this measure prior to treatment, with a higher mathematics attitude pretest group mean score for the comparison group, $t_{(240)} = 2.80$, $p = .006$. Because the two groups differed on the math attitude pretest, a univariate mixed model was conducted using the pretest as a covariate and the posttest as the dependent variable. Results of this analysis approached statistical significance, $F(1, 240) = 3.707$, $p = .055$. An additional set of follow-up *t* tests demonstrated that student attitudes toward mathematics declined significantly for the comparison group, $t_{(123)} = -2.25$, $p = .026$, but remained stable for the treatment group, $t_{(117)} = -1.21$, $p = .229$. See Table 5 for a complete reporting of the main effects on math attitudes over time.

Within the Fennema-Sherman Mathematics Attitudes Scale, the comparison group demonstrated significant decreases from pretest to posttest for the Effectance Motivation, $t_{(123)} = -2.06$, $p = .042$, and Usefulness constructs, $t_{(123)} = -2.50$, $p = .014$. The treatment group however, indicated no changes in any of the five constructs (see Table 6).

Table 5
Main Effects for Self-Efficacy and Attitude About Mathematics

Attitude Measure Pretest[a]	Attitude Measure Posttest	Change in Attitude	Significance	Significance Pretest	Self-efficacy Posttest	Changes in Self-efficacy[b]	Signficance
Comparison group (traditional schedule) n = 124							
M = 244.08	M = 240.64			M = 64.95	M = 67.27		
SD = 23.12	SD = 26.68	M = –3.44	p = .026	SD = 10.58	SD = 10.35	M =2.32	p = .012
Treatment group (block schedule) n = 118							
M = 236.14	M = 234.27			M = 63.34	M = 68.79		
SD = 20.88	SD = 24.65	M = –1.87	p = .229	SD =11.15	SD = 8.66	M = 5.45	p = .000

a. The two group means were found to be significantly different prior to treatment.
b. Change in self-efficacy was significantly greater for the treatment group (p = .009).

Another repeated measures ANOVA for self-efficacy revealed a significant change attributable to the schedule type (block or traditional), $F(1, 240) = 6.89$, $p = .009$, $\eta^2 = .028$. However, the practical significance of this finding was small. Follow-up paired t tests showed that both groups experienced significant increases in mathematics self-efficacy from pretest to posttest (treatment group, $t = 7.192$, $p < .001$; comparison group, $t = 2.548$, $p = .012$) but the changes in self-efficacy were significantly greater for the treatment group, $F(1, 240) = 2.951$, $p = .009$, $\eta^2 = .167$, indicating a moderate level of practical significance. See Table 5 for a complete reporting of the main effects on self-efficacy over time.

The items used for the self-efficacy measure were representative of the four main concepts assessed on the HSPEM: Algebra and Functions, Numbers and Operations, Geometry, and Probability and Data Analysis (Table 7).

The comparison group exhibited a significant decrease over the course of the study on the Algebra and Functions factor, $t_{(123)} = -2.51$, $p = .013$, and a significant increase on the Numbers and Operations factor, $t_{(123)} = 1.37$, $p < .001$, as well as the Geometry factor, $t_{(123)} = 5.82$, $p < .001$. No significant change was statistically detectable on the Probability and Data Analysis factor, $t_{(123)} = -1.48$, $p = .141$. The treatment group exhibited no significant change in the Algebra and Function factor, $t_{(117)} = -0.40$, $p = .691$, or the Probability and Data Analysis factor, $t_{(117)} = 0.74$, $p = .459$. However, a statistically significant increase was noted for the treatment group on the Numbers and Operations factor, $t_{(117)} = 7.44$, $p < .001$ as well as the Geometry factor, $t_{(117)} = 9.30$, $p < .001$. A follow-up test on the two factors that increased significantly for both groups revealed that gains reported on the Numbers and Operations self-efficacy factor were significantly greater in favor of the treatment group, $F(1, 239) = 4.906$, $p = .028$, $\eta^2 = .020$ but not significant on the Geometry self-efficacy factor, $F(1, 239) = 3.348$, $p = .069$, $\eta^2 = .014$. While a significant difference was found on the Numbers and Operations factor, a small effect size with little practical significance was noted ($\eta^2 = .020$).

Table 6
Subfactor Results From the Fennema-Sherman Mathematics Attitude Scale

Success Pre	Success Post	Effectance Motivation Pre	Effectance Motivation Post	Usefulness Pre	Usefulness Post	Teacher Pre	Teacher Post	Confidence Pre	Confidence Post
Comparison group (traditional schedule) $n = 124$									
$M = 51.94$	$M = 51.40$	$M = 44.66$	$M = 43.72$*	$M = 51.76$	$M = 50.43$*	$M = 47.42$	$M = 47.86$	$M = 48.29$	$M = 47.23$
$SD = 4.88$	$SD = 5.37$	$SD = 6.28$	$SD = 7.07$	$SD = 5.89$	$SD = 7.09$	$SD = 5.34$	$SD = 6.31$	$SD = 7.26$	$SD = 7.66$
Treatment group (block schedule) $n = 118$									
$M = 51.31$	$M = 50.93$	$M = 42.2$	$M = 41.92$	$M = 49.94$	$M = 49.75$	$M = 46.16$	$M = 45.56$	$M = 46.44$	$M = 46.11$
$SD = 4.51$	$SD = 5.08$	$SD = 5.88$	$SD = 6.35$	$SD = 6.50$	$SD = 7.21$	$SD = 5.06$	$SD = 6.06$	$SD = 7.36$	$SD = 7.68$

*Indicates significant changes at the $p < .05$ level.

Table 7
Subfactor Results From the Self-Efficacy Measure

Algebra and Functions Pre	Algebra and Functions Post	Numbers and Operations Pre	Numbers and Operations Post	Geometry Pre	Geometry Post	Probability and Data Analysis Pre	Probability and Data Analysis Post
Comparison group (traditional schedule) $n = 124$							
$M = 17.44$	$M = 16.67$*	$M = 15.52$	$M = 16.89$*	$M = 14.04$	$M = 16.16$*	$M = 17.95$	$M = 17.56$
$SD = 2.81$	$SD = 3.09$	$SD = 3.09$	$SD = 2.89$	$SD = 4.59$	$SD = 3.56$	$SD = 2.31$	$SD = 2.80$
Treatment group (block schedule) $n = 118$							
$M = 17.60$	$M = 17.50$	$M = 14.30$	$M = 16.64$*	M=13.89	$M = 16.91$*	$M = 17.55$	$M = 17.75$
$SD = 2.64$	$SD = 2.59$	$SD = 3.68$	$SD = 2.69$	$SD = 4.66$	$SD = 3.38$	$SD = 2.74$	$SD = 2.46$

*Indicates significant changes at the $p < .05$ level.

Additional repeated measures ANOVA tests were conducted to investigate trends in math attitude and self-efficacy that may have been attributed to course rigor or ethnicity. The addition of course rigor as a potential mediating variable was done in response to the literature review and yielded no significant differences for math attitude, $F(2, 235) = .695$, $p = .500$, $\eta^2 = .006$ or self-efficacy, $F(2, 235) = 2.293$, $p = .103$, $\eta^2 = .019$. In addition, ethnicity was introduced as another potential mediating variable in response to the disparity between the treatment and comparison schools on this variable to make sure that ethnicity did not make any spurious contributions to variance on the dependent measures. Results indicated that this did not occur for either math attitude, $F(4, 228) = 0.783$, $p = .537$, $\eta^2 = .014$ or self-efficacy, $F(4, 228) = 1.174$, $p = .323$, $\eta^2 = .020$.

Classroom Observations

Of the 14 classroom observations, 11 noted that the desks were set up in rows. Whereas a majority used a textbook during their lesson (93%), few of the classes used any mathematical manipulatives or equipment. Except for an overhead projector and one computer for the teacher to complete administrative tasks (36%), technology was not used. Almost all the teachers had rules and/or expectations posted in their classroom, half of them had achievement progress posted (i.e., grades) and one third of the observations noted a daily objective written on the whiteboard. A thematic analysis of these observations and field notes indicated no significant changes in teaching style over the 6 months of exposure to the alternating block schedule model. In addition, each observation was followed by a brief teacher interview designed to give teachers an opportunity to indicate if the observations were typical of their normal teaching routine and the behaviors of their students. In approximately 90% of these postobservation interviews, teachers indicated that the classes observed typified both their normal teaching routine and normal behaviors of their students.

Although most of the observed instructional activities were traditional in nature, (lecture, note taking, individual practice, review of homework problems, etc.) almost all the instructors delivered at least three distinct instructional activities over the 85-min period. In fact, when one teacher is removed from the sample, the remaining six averaged almost four instructional activities per class period where 70% of the activities consisted of lecture and/or large group instruction. Technology use was noted in only two of the observations (14%), and these activities consisted of the students observing their teacher use the technology tool(s). In less than 10% of the observations were students observed working in small groups, and the majority of instruction was didactic and teacher directed.

Student Focus Groups

Student comments were open coded into six categories: class activities, connections with teachers, attitude toward block schedule, balance of schedule, student attitude

toward learning mathematics in block schedule, and learning. Comments were then noted as having a positive, negative, or neutral valance and were tallied by school and totaled for all participating students. Overall, student attitude toward block schedule was positive (45%). Students were especially excited about the opportunity to have their academic classes every other day, giving them a "break" day to digest the material and to complete homework assignments. This trend in the scheduling where an academically rigorous day was followed by a less academically rigorous day allowed for better management of time for homework and other activities outside of the school. This theme was unanticipated and emerged from the open discussion with students at the second school. Once the theme emerged, it was supported at each subsequent school when prompted. Even though several students mentioned a dislike for the "stacked" schedule concept, most of them commented that it was working well for them, and these students felt that they were achieving better academically as a result.

In contrast to the classroom observations, students did not feel that teachers were using the additional time provided by the block schedule to vary their instructional activities (18%). Most of the comments were favorable for seeing each teacher every other day as opposed to every day. However, the students indicated that they were doubtful if any personal connections with teachers were established. Student responses to question prompts around the constructs of learning and attitude toward learning mathematics on a block schedule were inconclusive, and discussion around these topics was minimal at each school.

Discussion

The statistical analysis of the survey responses suggests that the implementation of the alternating block schedule model in the three treatment high schools did result in significant changes in student attitude toward themselves and for learning mathematics, though the effect size was small. While both groups experienced increases in their attitude toward themselves as learners, students learning in the block schedule made significantly greater gains with relatively small levels of practical significance. Students learning in the block schedule also held more stable attitudes toward mathematics whereas students learning in a traditional schedule experienced significant decreases in attitude. Although the results from the current study do demonstrate positive trends in student attitudes and self-efficacy as a result of implementing the alternating block schedule model, the small effect size coupled with the fact that the two groups were not equivalent on this measure prior to treatment raise questions about the validity of the results. Because the students learning in the block schedule showed lower attitudes toward mathematics prior to treatment, we cannot conclude with confidence that these results could be replicated.

Students of varied backgrounds and academic experiences responded similarly to the alternating block schedule model, suggesting that this innovation can assist students with unique abilities and work habits. However, it is our contention that

future research on block scheduling should continue to be designed to investigate whether students with differing backgrounds and abilities respond differently to the innovation as implementation fidelity was not consistent across schools and had little effect on teacher behavior. Indeed, a good degree of variation existed in the way schools implemented the alternating block scheduling model. While some provided additional time for staff members to serve as mentors to students and worked to build smaller learning communities, other schools, inundated by extreme student growth, were forced to break block periods into smaller segments in order to efficiently provide each student access to the cafeteria to eat lunch.

In spite of these promising changes in attitude and self-efficacy, the classroom observations highlighted the need for intense professional development related to using the additional time provided in a block schedule effectively. The focus group results suggest that students were either in favor of block schedule or indifferent to it, yet most of their reasons were external to the daily activities conducted within the classroom (e.g., the opportunity to take more electives or having two days to complete homework assignments). The lack of comments about changes within the classroom was supported by the observation results indicating that little change occurred in the number and type of teacher-initiated activities and strategies over the course of the school year.

Student focus group discussions did indicate that having a majority of their academically challenging courses on the same day was an important perceived benefit of being on a block schedule. To our knowledge, this exists as an unintended consequence and is a compelling finding worthy of further investigation. While few students expressed feelings of a better connection to their teachers, several students indicated that this was more likely because of significantly larger class sizes, a confounding variable in this case.

The effects of block schedule remain hard to gauge, and replicating results are difficult as implementation appears to vary by school site. The current research has opened the door to another set of contextual factors within the school that could complicate interpretations further. However, the results seem clear in that simply adding instructional time to the day will not have a direct impact on classroom practice. The results reported here suggest that the additional time created by a block schedule was used to repeat the instructional strategies previously used in a traditional schedule. If reformed teacher practice is a goal of transitioning to a block schedule, then professional development is critical.

Although professional development looms as paramount for reforming teacher practice to maximize the time advantages of a block schedule, the variety of hybrid implementations and interschool factors present an even greater challenge to district leadership as "one size fits all" professional development may not adequately meet the needs of teachers. Although the mere restructuring of a school's bell schedule can bring about short-term changes in school climate, these changes may not outweigh the impending professional development costs required to maximize the affordance of the additional instructional time.

Appendix
Focus Group Questions

Do you see your teachers conducting different activities on a block schedule compared with last year (on a traditional schedule)?

Do you feel that students have enough time to digest and understand the mathematics concepts considering there are less contact hours?

Are you concerned about having less contact time not only with the teacher but with the subject? Since mathematics is so "review heavy" do you have a hard time understanding?

Do you feel overwhelmed? Since more concepts would be introduced each class period, do you struggle?

Are you still able to make strong connections with teachers?

When learning a new topic in mathematics, do you try to see how it relates to other mathematics topics or topics you have learned before? Is relating new topics to other topics something your teacher stresses?

How are you graded on block schedule and how does it compare to grading procedures in previous years not on a block schedule?

On a scale of 1 to 10, with 10 being the highest, how much do you like block schedule? What specific things do you like and dislike about block schedule?

Does (or would) the practice of letting some students do more or less work than others affect how hard you work in the class where this happens? (Probe for examples).

How do you like mathematics in comparison to other subjects? Are the factors that make you work hard in other subjects different from the ones that make you work hard in math?

Are you influenced by what your friends think about block scheduling? How do they influence you?

Do you care about what your classmates and teacher think of your skills in math? Is it important to you to look like a good mathematics student or poor mathematics student to your friends and teacher? (look for evidence of an ego-orientation [trying to do better than others])

Do teachers allow you to complete homework during class time?

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