LESSONS LEARNED AROUND THE BLOCK: AN ANALYSIS OF RESEARCH ON THE IMPACT OF BLOCK SCHEDULING ON SCIENCE TEACHING AND LEARNING

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ABSTRACT: The purpose of this study was to provide a comprehensive review of the literature surrounding block scheduling to better understand what the last twenty years of research reveals about the impact of block scheduling on science teaching and learning. Forty-five selected articles were examined for arguments or reasoning as supporting block scheduling, opposing block scheduling, or stating that block scheduling did not make a difference in the argument. Five categories emerged: 1) organizational issues, 2) curricular issues, 3) instructional issues, 4) learning outcomes, and 5) disciplinary issues. The arguments/reasons were further analyzed into 23 sub categories, with the number of studies for each argument recorded. Data from 31 studies supported, data from 30 studies opposed, and data from 16 studies stated that block scheduling did not make a difference for that argument. Issues associated with block scheduling included school funding, presumed science benefits, teacher retention and student learning outcomes.

Keywords: block scheduling, science education, secondary education, policy

INTRODUCTION

Standards-based instruction and accountability has driven educational reform for many years (Donnelly & Sadler, 2009). The standards movement has sought to quantify students, teachers and schools to a measurable value that can be better understood, rated and ultimately improved. Students, teachers and schools are held accountable by publically acknowledging the measured values. Under the No Child Left Behind (NCLB) federal legislation of 2001, federal grant monies were only given to districts making adequate yearly progress (AYP) towards goals of improvement of their scores. An important subgroup is the low socioeconomic status (SES). School districts are instructed to close the achievement gap so that all students are learning at high levels, producing higher and higher scores. The Every Student Succeeds Act (ESSA) of 2015 shifted control back to the states for closing achievement gaps and advancing equity in the lowest-performing schools (U.S. Department of Education, 2016).

One reform strategy many schools are choosing to utilize to improve student performance on accountability measures is a change in scheduling (Bonner, 2012, Huelskamp, 2014). Block scheduling elongates classes into larger "blocks" of time, usually 90 minutes or more, that meet less frequently (O'Neil, 1995; Zepeda & Mayers, 2006). The concept is not new. As many as 15 percent of junior high and high schools experimented with "flexible modular scheduling" in the 1960s and 1970s before abounding the 20 minute chunks of time modules that could be scheduled to elongate or shorten classes (Bonner, 2012; O'Neil, 1995). When the National Commission on Excellence in Education published *A Nation at Risk* in 1983, "time on task" became a focus of educational reform (Gullatt, 2006; National Commission on Excellence in Education, 1983). Block scheduling was seen as a way to break with traditional and antiquated models and use time in the classroom more efficiently (Bonner, 2012; Dostal, 2010; Gullatt, 2006).

Joseph Carrol published *The Copernican Plan: Restructuring the American High School* in 1990 and the National Education Commission on Time and Learning published *Prisoners of Time* in 1994, increasing interest in block scheduling as a tool for additional reform (Carroll, 1990; Cawelti, 1994; National Education Commission on Time and Learning, 1994). By 2003, 31.8% of all secondary schools in the United States utilized block scheduling (National Center for Education Statistics, 2003). The 31.8% of all secondary schools figure represents 34.5% of all public and 23.6 % of all private secondary schools in the U.S. (National Center for Education Statistics, 2003). Charter schools, available to more easily experiment with time and resources, utilize block scheduling more than other public schools (O'Brien, 2006). In North Carolina, 53.7% of all secondary schools utilized block scheduling in 2003 (National Center for Education Statistics, 2003). Only two states, Maine (56.8%) and Maryland (63.1%), and the District of Columbia (65.8%) had higher percentages of schools on the block schedule than NC in 2003 (National Center for Education Statistics, 2003).

Other countries have also embraced block scheduling, with Canada's British Columbia reporting one third of secondary students studying in blocked scheduled courses in 1990 (Bateson, 1990). Bateson (1990) found that students in the traditional year-long science course outperformed students in block scheduled classes in cognitive domains tests. Absent American push for educational reform, why are other countries moving to block scheduling? Perhaps economic and teacher retention issues come into play. Some school districts have suggested moving to the block as a way to save money in textbook purchases and teacher salaries (Yount, 2010). Although schools that keep class size constant spend more money in block scheduled classes due to the need to hire more teachers (Hamari, 2010).

Whether used to increase standardized test scores, improve student time of engagement, or in saving money, block scheduling does deliver a change to the school day and that draws both praise and criticism. The two most common forms of block scheduling are a 4x4 schedule whereby students take four classes each semester and an AB or an 8x2 schedule whereby students take four classes every other day for the entire school year (Bateson, 2009; O'Neil, 1995; Zepeda & Mayers, 2006).

Reallocating the school day into longer class periods provides opportunities for restructuring teaching methodologies that are more active and therefore increase active student learning in measureable ways (Huelskamp, 2014; Jordan & Padilla, 1999). Block scheduling of classes allows students to take more elective courses in the areas they might otherwise have weak performance (Gullatt, 2006; Queen, Algozzine & Eaddy, 1997) and allows students to repeat a course they failed in the same year without falling behind in their grade level and thus increasing graduation rates (Gullatt, 2006). Block scheduling of classes allows teachers to team teach subjects (Gullatt, 2006; Weller & McLeskey, 2000) and have a larger arsenal of instructional activities (Gullatt, 2006; Jones, 2009; Queen et al., 1997; Weller & McLeskey, 2000). Block scheduling of classes allow administrators flexibilities in scheduling (Queen et al., 1997; Weller & McLeskey, 2000), such as having weaker English students take vocabulary-rich Biology in the spring.

However, blocked schedule courses have less overall instructional time which often means less content is covered (O'Neal, 1995; Queen et al., 1997; Zepeda & Mayers, 2006). Blocked schedule courses meet on half as many days and have half as many breaks between classes which translates into students doing less homework to reinforce concepts (Jones, 2009). Even though block scheduling has been implemented in many secondary schools in the nation, its impact on student learning is still controversial. One often cited method of measuring student learning is a standardized test score. Some studies have found that standardized test scores increased with transition to a block schedule (Trenta & Newman, 2001; Lewis, 2005), some studies have found that standardized test scores decreased with transition to a block schedule (Gruber & Onwuegbuzie, 2001; Harmston, Pliska, Ziomech & Hackman, 2003) and even more studies have found that block scheduling did not make a difference in students' performance as measured by a standardized test (Bonner, 2012; Dostal, 2010; Zepeda & Mayers, 2006).

People in favor of block scheduling often use science classes as a major beneficiary because it allows for more instructional learning activities including laboratory experiments requiring longer periods of time (Gullatt, 2006; Jones, 2009). Research shows science teachers who have transitioned to the block schedule often prefer to stay with block scheduling (Jones, 2009; O'Neal, 1995). Nevertheless, the specific impact of block scheduling on learning environment and student learning in science remain uncertain. Since schools are ultimately held accountable for their government tax dollars, if schools adopt block scheduling, they should have research-based evidence to support it.

In this regard, we conducted a comprehensive literature review to understand what research tells us about the impact of block scheduling on science teaching and learning. By doing so, we can help administrators and educators make informed decisions on scheduling.

METHODS

Selection of the Literature related to Science Teaching and Learning

The literature for this review was selected from *peer-reviewed journals* from 1996-2016 relating to high school science teaching and scheduling type. An electronic search using the search engine EBSCOhost was performed with the search terms "block scheduling" and "high school." The search located about 215 articles that could be possibly included in our review. Next, individual abstracts of the identified articles were carefully reviewed for connections to science teaching and learning. Articles of interest were read to find additional articles. This resulted in the selection of a total of 45 articles for in-depth review for this study.

Analysis of the Literature related to Science Teaching and Learning

The 45 selected articles were coded by their argument/reasoning relating to block scheduling, type of publication, methodology used in research, and the empirical evidence supporting the argument. Arguments themselves were identified as supporting block scheduling, opposing block scheduling, or stating that block scheduling did not make a difference in the argument. All arguments were then contrasted and compared to one another to identify relations across them. As a result, five categories emerged: 1) organizational issues, 2) curricular issues, 3) instructional issues, 4) learning outcomes, and 5) disciplinary issues. Other themes that immerged did not make an argument for or against block scheduling.

FINDINGS

Five themes emerging from our analysis are summarized with the number of studies in Table 1.

Table 1. Categories with empirical evidence

Categories and Subcategories	In favor	Opposed	No difference
1. Instructional Issues			
More variety of instructional activities, including team teaching	5	1	1
Less experiential education activities		1	
Teachers have longer planning periods & fewer class preparations	2		
Fewer minutes of overall instruction in block courses, transition and class management longer		5	
Increase in organization, communication, independent study, homework		4	
Transition difficult for students and teachers		3	
2. Learning Outcomes:			
GPA, academic focus increase	3	1	4
Standardized test, post-test performance	2	5	6
More remediation & enrichment	1	1	
AP classes negatively impacted		1	
Loss of retention between courses		1	
College performance			3
3. Curricular issues:			
Repeat failed course without falling behind in grade level	1		
More courses, more elective course offerings	4	1	
Less material covered		1	
4. Organizational issues			
Student attendance	2	2	2
Scheduling extracurricular activities	1		
More flexibility in scheduling	2		
Students may graduate earlier, transfer process easier	1	1	
5. Disciplinary issues			
Improved school climate	5		
Decreased discipline referrals	2		
Larger class sizes		1	
Student interest diminishes/ students bored		1	
Total:	31	30	16

Support of Block Scheduling

Proponents of block scheduling discuss many favorable aspects such as increased number of instructional activities (Gullatt, 2006), higher grades (Zepeda & Mayers, 2006), flexibility (Queen et al., 1997) and improved school climate (Stader, 2001).

Instructional issues. Because of the longer time periods, block scheduling provides an opportunity for more variety in instructional activities such as cooperative learning, student inquiry and team teaching (Gullatt, 2006; Jones, 2009; Weller & McLeskey, 2000). Jones (2009) found that teachers used a greater variety of assessments, graphic organizers and less student inquiry in study surveying 155 science teachers four years after moving to block scheduling. Teachers teaching on a blocked schedule spend 75% of their time teaching while seven-period day schedule teachers spend 86% of their time teaching (Yount, 2010). Longer planning periods and fewer class preparations (O'Neil, 1995; Queen et al., 1997) could also add to a more positive school climate, increasing teacher retention.

***Learning outcomes*.** Evans, Tokarczyk, Rice, and McCray (2002) reported block scheduling can benefit learning outcomes for high and low achievers by providing opportunities for more remediation and enrichment. Some studies found that students on the block schedule earned higher GPA scores (Lare, Jablondky & Salvaterra, 2002; Zepeda & Mayers, 2006). In a longitudinal study of 500 small, Midwestern high school students, Trenta and Newman (2002) found a statistically significant relationship in the GPA of individual subject areas when students on a block schedule was compared to students on a traditional schedule. Examining standardized test scores, Bonner (2012) found significant gains in African American students taking the biology End Of Course test in North Carolina when on the block schedule. GPA scores could also be higher with an extra elective course provided on the block schedule (Bonner, 2012). Non-core elective courses would circumvent the expectation of reformists reacting to *A Nation at Risk* (National Commission on Excellence in Education, 1983).

***Curricular issues*.** Block scheduling can impact the curriculum in ways helpful to students and administrators. On the 4x4 block, students may repeat a course failed during the first semester during the second semester without falling behind in grade level for the next school year (Gullatt, 2006). Since students take eight total courses on the block schedule, after meeting core course requirements, are allowed to take more courses in general and more elective and accelerated courses (Gullatt, 2006; Queen et al., 1997; Weller & McLeskey, 2000).

***Organizational issues*.** Block scheduling offers more flexibility in scheduling (Queen et al., 1997; Weller & McLeskey, 2000) and provides an opportunity for extra-curricular clubs and activities to meet during the school day rather than after school (Gullatt, 2006). An area of great interest is the impact of block scheduling on student attendance. Two studies found that moving to the block schedule increased student attendance (Jordan & Padilla, 1999; Queen et al., 1997). Queen et al. (1997) collected data of three different North Carolina high schools prior to moving to block scheduling and during the first two years of being on the block schedule.

***Disciplinary issues*.** Administrators have noted a decrease in discipline referrals from teachers when moving to the block schedule (Queen et al., 1997; Stader, 2001). This might be due to a noted improvement in school climate (O'Neil, 1995; Stader, 2001; Weller & McLeskey, 2000). Zepeda and Mayers (2006) analyzed 58 empirical studies of block scheduling in high schools noting that students and teachers liked the block schedule, although their reasons are largely unknown. A major driving force for teachers was having a longer planning period (Jones, 2009). Perhaps a contributing factor for students on the block schedule is that with less course content, blocked classes are described as being easier than traditional classes (Zelkowski, 2010).

Opposition to Block Scheduling

Opponents of block scheduling discuss negative aspects of block scheduling such as less instructional time (Queen et al., 1997) and loss of student attention span (Wilson, Looney, & Stair, 2005).

***Instructional issues*.** Even though there is opportunity for more variety of instructional activities, other factors impact which instructional activities are implemented. There is often less instruction time in blocked courses due to fewer minutes of overall instruction (O'Neil, 1995; Queen et al., 1997), transition time and class management taking longer (Smith, Monnat, & Lounsbery, 2015), and more time needed in class to do what was often completed as homework outside of class (Jordan & Padilla, 1999; Weller & McLeskey, 2000). It is difficult for students to adapt to more activities (Weller & McLeskey, 2000) and it is difficult for teachers to adapt (Harmston et al., 2003). One study found that teachers lectured more on the block schedule (Queen et al., 1997) and one study found that the number of experiential education activities decreased on the block schedule (Wilson et al., 2005). Schools utilizing block scheduling to improve test scores often also proscribe instructional activities with pacing guides and non-inquiry based activities (Scot, 2009).

***Learning outcomes*.** Using standardized tests as a measure, traditional schedule students performed better than block schedule students on standardized tests in science, language arts, social studies and math in Georgia (Gruber & Onwuegbuzie, 2001). Traditional schedule students demonstrated an upward trend nationally in ACT scores while schools on a block schedule experienced a peak near the year of implementation and then leveled out or declined (Harmston et al., 2003). Gullatt (2006) found that block scheduling did not meet the expectations intended for advanced students and Jordan and Padilla (1999) found that lower level students did not perform as well with the fast pace of the block schedule. AP classes were negatively impacted (Gullatt, 2006) and there is loss of retention from one course to the next level (Queen et al., 1997) on a 4x4 block schedule.

***Curricular issues*.** Block scheduling can impact the curriculum in ways that are not helpful to students or administrators. Some schools experienced a limited number of new electives (Queen et al., 1997) because without

additional resources, the same number of teachers are teaching the same number of students but in additional courses. Because of the decrease in amount of time in a block schedule course, 12.5% less than a traditional schedule course, less content is covered (Zepeda & Mayers, 2006). Elective courses, often stand-alone courses, might not be impacted as much when less content is covered, but the reduction is content is magnified in core and sequential courses. Jones (2009) found that EOC teachers felt significantly more pressure to cover the curriculum than non EOC teachers on the block schedule.

***Organizational issues*.** Block scheduling increases the need for efficient and effective communication and increases the significance of student absences (Weller & McLeskey, 2000).

***Disciplinary issues*.** Larger class sizes (Smith et al., 2015), concern for relating to bored students and keeping student interest in long 90-minute classes (Wilson et al., 2005) can increase discipline problems. First year block schedule teachers used 11% more time than experienced teachers to manage discipline problems (Queen, Algozzine & Isenhour, 1999).

DISCUSSION AND IMPLICATIONS

We reviewed 45 block scheduling studies published during the past 20 years. Based on the review, we found several issues associated with research on block scheduling. First, arguments for block scheduling often promoted more nonacademic, organizational, discipline and curricular outcomes. This is consistent with Lewis' (2005) study that showed that "block scheduling often results in better nonacademic outcomes than does traditional scheduling," (p. 85). Many studies pointed to changes to school funding without describing how the school budget was changed. For example, increased instructional activities (Jones, 2009) would require additional instructional funding while teachers teaching more students during the year (Wilson et al., 2005) could mean that less funding for teacher salaries is needed. More research is needed on how block scheduling impacts school funding.

Second, science classes were presumed to take advantage of longer time periods in a blocked schedule to do longer laboratory experiments but research found science teachers actually did less laboratory experiments in EOC classes (Jones, 2009) or no difference in teachers instructional practices (Maltese, Dexter, Tai, & Sadler, 2007; Zepeda & Mayers, 2006). More research is needed on how block scheduling specifically impacts science classes.

Third, professional development for teachers has increased in significance in providing fulfilling longer class periods (Biesinger, Crippen & Muis, 2008; Dostal, 2010; Gullatt, 2006; Nichols, 2005). There is a lack empirical data on how professional development has been implemented. In light of vacancies in science teacher positions, more research is needed to understand block scheduling impacts on teacher fulfillment and retention.

Last and most importantly, there is little empirical evidence that block scheduling does advantage learning outcomes. Studies cite the opportunity block scheduling provides for more variety in instructional activities (Gullatt, 2006; Jones, 2009; Weller & McLeskey, 2000) however, block scheduling of classes often creates larger class sizes which cause teachers to resort to traditional lecture and worksheet methods of instruction (Veal & Flinders, 2001). More well-designed empirical studies on the specific impact of block scheduling on student learning outcomes as well as teacher instructional decisions are imperative given that more schools have been implementing block scheduling.

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