July 14, 2020

MEMORANDUM

To: Board of Education Members

From: Michael Martirano, Ed.D.
Superintendent

Subject: Additional Information on the 4x4 Block Schedule

This purpose of this memo is to provide you with additional information on the 4x4 block schedule. As you know, the Board voted to adopt the 4x4 schedule for secondary schools for the 2020-2021 school year only. The recommendation was presented to the Board of Education after careful examination of various scheduling models by a team of school-based and central office staff. The recommendation was anchored in the pursuit of a scheduling model that prioritized the following:

- Optimization of the safety, health, and well-being of students and staff.
- A schedule that is portable across fully virtual, hybrid, and fully face-to-face learning conditions.
- A schedule that mitigates concerns about the student and staff workload as they work together in an unfamiliar learning model.
- A schedule that research affirms is comparable to the current schedule.

The 4x4 block schedule was preferable to the 7-period day schedule when considering each of the first three items in the bulleted list. As for research, a team has worked to compile a literature review with the understanding that there has not been research advanced for a 4x4 block schedule as a tool to mitigate conditions associated with a worldwide pandemic. The executive summary of that literature review can be found in Appendix A and the research highlights can be found in Appendix B. One important caveat, ***Conclusions from existing research may not apply to the current context in the Howard County Public School System (HCPSS).*** For example, while working in a fully face-to-face model, students working in a 4x4 block schedule experience a 90-minute class period. However, in a fully virtual model, students would be engaged in synchronous learning between 45-60 minutes each day so that research informing digital instruction are put into practice. The remaining 30-45 minutes of learning will be accounted for in an asynchronous manner.

Over the past week, there has been a great deal of discussion about the impact of the 4x4 schedule on Advanced Placement (AP) exams. As you will read in the research highlights, studies produce mixed results with the full range of impacts described. (no impact, positive impact, and negative impact) To

ensure that our students are as fully prepared as possible for their AP exams, schools will be encouraged to develop support structures both within and outside of their school day schedule. In addition, curriculum staff will be helping our teachers and students take full advantage to the suite of College Board resources for AP courses and exams, including the video lessons and exam preparation tools.

Staff stands ready to engage in a full discussion with the Board of Education during upcoming work sessions.

If you have any questions, please contact William Barnes, Chief Academic Officer.

**Appendix A – Executive Summary of the HCPSS Literature Review on the 4x4 Block Schedule**

## Executive Summary

This brief review of the literature focuses on the 4x4 semester block schedule at the high school level. According to Zepeda & Mayers (2006), block schedules include several variations:

1. The 4x4, in which the school day is divided into four roughly equivalent blocks of time, usually 80 to 90 minutes each. Following a university model, students in a 4x4 schedule begin new courses twice a year.
2. Another variation is the trimester schedule, in which the year is divided into three terms instead of two as in the 4x4 block schedule.
3. In the alternating block, also called the A/B block, students meet every other day throughout the school year and typically enroll in six to eight classes, each lasting between 70 and 90 minutes.

**Limitations of the literature** - ***Conclusions from existing research may not apply to the current context in the Howard County Public School System (HCPSS).***

- None of the studies examined outcomes in a virtual learning setting. **It is crucial to assess whether purported benefits and disadvantages of block scheduling on outcomes is generalizable to a virtual environment**. For example, a science teacher may prefer longer period blocks that are more conducive to laboratory class work; however, in a virtual learning environment, this benefit may no longer be achieved.
- Almost all of **these studies focused on high schools** and not middle schools.
- The proposed 4x4 schedule in HCPSS consists of 45 minutes of synchronous instruction, and approximately 100 minutes of asynchronous assignments and work time. This **amount of proposed instructional time differs from the research on block schedules**, which is described as having face-to-face class periods that are about 80 to 90 minutes long.
- The 4x4 schedule as proposed in HCPSS is intended for one school year only. **Studies cited reviewed outcomes for students and faculty who have experienced the semester block scheduling for multiple years**.
- **Some studies do not define what block schedule variation is examined**, and may be comparing any of the above block schedule variations to the traditional schedule.
- **All of the quantitative studies cited employed correlational methods with statistical controls** to attempt to isolate the effect of scheduling on the intended outcomes. To the extent that any confounding variables were unaccounted for in the models, findings are to that degree less valid.

**Findings**

1. **As a whole, the evidence neither supports nor refutes block scheduling over traditional scheduling at the high school level.**

    - Several reviews of the literature over time (Holley & Park, 2017; Mizhquiri, 2019; Zepeda & Mayers, 2006) all came to the conclusion that **individual studies exist both to support and refute block scheduling over traditional scheduling; or found no data to support that scheduling type was related to different outcomes.**

2. **Anecdotally, professional organizations have put forth statements related to block scheduling**. For example, the National Education Association (NEA) claims that advantages and disadvantages of block scheduling in a face-to-face setting include:

| Advantages of **face-to-face** block scheduling: | Disadvantages of **face-to-face** block scheduling: |
|---|---|
| Teachers see fewer students during the day, giving them more time for individualized instruction. | Teachers see students only three to four days a week which fosters a lack of continuity from day to day. |
| With the increased span of teaching time, longer cooperative learning activities can be completed in one class period. | If a student misses a day under the block schedule, that student is actually missing two, or sometimes even more days. |
| Students have more time for reflection and less information to process over the course of a school day. | In a 4x4, all of the information normally taught in a semester course has to be covered in one quarter. |
| Teachers have extended time for planning. | It is difficult to cover the necessary material for Advanced Placement courses in the time allotted. |

3. **Ultimately, the decision to implement any practice, including scheduling type, depends on the local context.**

   Some areas to consider include **stakeholder input**, **change management**, **funding and budgetary implications**, staff **professional learning** needs, and the overall **teaching and learning experience**.

   - **Teaching and learning areas of considerations** may range from instructional time management as teachers transition from a 50-minute face-to-face block to a virtual 55-minute synchronous block, to credit transfers for students transferring into HCPSS from schools not running on the 4x4 semester block schedule.
   - In terms of **stakeholder input**, one item on the distance learning and fall planning survey asked respondents to indicate whether they preferred the traditional seven-class schedule or the 4x4 block schedule in middle and high schools for school year 2020-21 (HCPSS, 2020). Across students, staff, and parents/guardians who responded, in general, **about 1 in 3 respondents expressed a need for more information** before making a preference for the secondary schedule. **For the remaining respondents, in general, more students preferred the current daily seven-class schedule; whereas more staff and parents/guardians preferred the block schedule.**

**Appendix B – Research Highlights from the HCPSS Literature Review on the 4x4 Block Schedule**

## Research Highlights

In a recent comprehensive review of the literature on the impact of block scheduling on **high school science education**, Holley and Park (2017) came to these conclusions after selecting 45 studies for review:

- **The evidence on 4x4 scheduling as it relates to teaching and learning outcomes is mixed.** The 45 studies yielded 77 findings, about 40% of which supported, another 40% did not support, and 20% concluded no difference in block scheduling compared to traditional scheduling on the outcomes examined.
    - Five categories emerged in which outcomes were examined: (a) organizational issues, (b) curricular issues, (c) instructional issues, (d) learning outcomes, and (e) disciplinary issues.
    - Issues associated with block scheduling included school funding, presumed science benefits, teacher retention, and student learning outcomes.

**Some studies suggested positive social-emotional outcomes related to the 4x4 schedule when compared to the traditional schedule.**

- Lewis et al. (2003) summarized the literature (late 1990s) on 4x4 schedules in high school, concluding that the **4x4 semester plan format may increase the number of students per class, but facilitates a more positive classroom climate** (better student-teacher relationships, fewer discipline concerns).
    - Considering non-achievement outcomes, **findings tend to favor both forms of block scheduling over traditional scheduling on such things as school climate** (i.e. Bickel, 1999), **student satisfaction with school** (Lapkin et. al, 1997; Knight, De Leon, & Smith, 1999)—**except students in AP classes** (Knight et al, 1999), and **teacher, parent, and counselor satisfaction with school** (Edwards, 1999; Wilson & Stokes, 1999; Deuel, 1999).
- According to Lewis et al. (2003), the **4x4 schedule offers teachers a manageable timetable**, as they teach three classes with a daily planning period rather than five or six classes with a planning period every other day.
- Zepeda & Mayers (2006) reviewed 58 empirical studies on block scheduling in high school. Among the outcomes included, they found **more consistency across studies that block schedule schools had better disciplinary outcomes than traditional schedule schools**. Note that **in one study cited, teachers and students in a 4x4 schedule had differing perceptions, with teachers perceiving better but students perceiving worse disciplinary outcomes in a 4x4 schedule compared to a traditional schedule**.
- Also cited in Zepeda & Mayers (2006): Pisapia and Westfall's (1997c) results reported positive student reactions, suggesting that the **perceptions of students in a 4x4 block schedule were more positive than those of students in an alternating block schedule**.
- Zepeda & Mayers (2006) summarized Evans et al.'s (2002) research, which did not indicate how many participants were involved, used interviews and focus groups of teachers, students, and parents at 3 New Jersey schools to examine overall perceptions of block scheduling. **Evans et al. reported that the number of disciplinary referrals decreased following the implementation of a block schedule**.

**On the other hand, studies suggest either no difference or mixed findings for a 4x4 schedule in high school and academic achievement when compared to the traditional schedule.**

- Gruber and Onwuegbuzie (2001) found that the Class of 1997 from one Georgia high school who had the traditional 6-period schedule for four years, achieved higher scores on the state high school graduation assessments in Math, English, Science, and Social Studies than a later cohort of students in the Class of 2000 from the same high school who had the 4x4 schedule for three years. In other words, the **4x4 schedule was linked to lower academic achievement when compared to the traditional 6-period schedule**.
- Harmston et al. (2003) compared trends in mean ACT scores of 480 Illinois and Iowa high schools that implemented an 8-period traditional schedule, an 8-period alternating day block schedule, or a 4x4 semester block schedule. After reaching a peak at or near the year of implementation, **the 4x4 semester block schools demonstrated a generally declining trend in mean ACT scores across tests**. With the exception of Reading, mean ACT scores rebounded somewhat at the fourth year post-implementation for the 4x4 semester block schools. **The 8-period traditional schedule schools, on the other hand, demonstrated increasing trends in ACT means**.
- Zelkowski (2010) found that high school students who followed a 4x4 schedule performed lower in math than students in the traditional schedule. He concluded that **non-continuous enrollment in secondary mathematics results in lower mathematics achievement.** Nationally, schools following 4x4 block schedules (90-minute classes that meet daily for only one semester) were found to have NAEP-HSTS 2005 mathematics achievement scores two thirds of one grade-level lower than schools following a 50-minute year-long mathematics courses.
- Holley and Park (2017): **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).
- Lewis et al. (2003) summarized: **block scheduling does not produce worse achievement outcomes than traditional scheduling**.
- The impact of block scheduling on **AP exam scores was mixed**. As summarized by Zepeda & Mayers (2006), increased AP exam scores for block-scheduled students were reported by Evans et al. (2002). In contrast, Knight et al. (1999) and Snyder (1997) reported that AP exam scores dropped after implementation of a block schedule. Adding even more inconsistency to these results, Duel (1999) reported that block scheduling had no significant effect on standardized scores, including AP exam scores.

**Research Study Summaries**

| Gruber, C. D., & Onwuegbuzie, A. J. (2001). Effects of block scheduling on academic achievement among high school students. *The High School Journal, 84, 32-42.* |
|---|
| **Focus**: Relationship b/w traditional and 4x4 schedule on HS students' academic performance as measured by the Georgia HS Graduation Test |
| **Key guiding question & finding**:<br>• No difference in writing scores on Georgia High School Graduation Test<br>• For Math, English, Science, Social Studies: students in traditional schedule had higher scores than 4x4 peers |

**Slightly more detail**:

- Although block scheduling has become increasingly popular in the past decade, only a few researchers have investigated its effect on academic achievement. Therefore, this study was conducted to determine the effects of block scheduling on academic achievement between 115 high school students who received instruction via a 4×4 block schedule and 146 students who received instruction via a traditional schedule. A series of independent t-tests, utilizing the Bonferroni adjustment, was conducted to compare grade point averages and scores on the Georgia High School Graduation Test (GHSGT) between the two groups. Findings revealed no statistically significant difference in grade point averages or in scores on the Writing portion of the GHSGT between the two groups. However, statistically significant differences were found for Language Arts (Cohen's d = .34, moderate), Mathematics (d = .52, large), Social Studies (d = .51, large), and Science (d = .46, large) scores. For each of the statistically significant differences, students who received instruction via a traditional schedule received the higher GHSGT scores.

Lewis, C. W., Dugan, J. J., Winokur, M. A., & Cobb, R. B. (2005). The effects of block scheduling on high school academic achievement. *National Association of Secondary School Principals (NASSP) Bulletin, 89*, 72-87.

**Focus**: Relationship b/w traditional and 4x4 schedule on HS students' academic performance as measured by student gain scores on ACT math and reading sections

**Key guiding questions & findings**:

- Results indicate that students in 4x4 block scheduling had greater gain scores in reading and mathematics than did students in both traditional scheduling and A/B block scheduling.

**Slightly more detail**:

- The effect of block scheduling on high school student achievement in mathematics and reading was investigated in this study through the use of an ex postfacto, longitudinal research design. Specifically, student scores from 9thand 11th-grade standardized tests were matched and sorted by junior high and high school attended. Outcome measures consisted of Levels tests and ACT exams in mathematics and reading. Statistical analyses of student gain scores included main effects of scheduling type, gender, and ethnicity as well as interaction effects for these independent variables. Results indicate that students in 4x4 block scheduling had greater gain scores in reading and mathematics than did students in both traditional scheduling and A/B block scheduling.
- Method:

Lewis, C. W., Cobb, R. B., Winokur, M., Leech, N., Viney, M., & White, W. (2003). The effects of full and alternative day block scheduling on language arts and science achievement in a junior high school. Education Policy Analysis Archives, *11*, 1-25.

**Focus**: 4x4 scheduling in high schools

**Key guiding question & finding**:

1. What is the effect on science content, science process, and language arts achievement of learning that content in 4x4 block scheduling, AB block scheduling, or traditional scheduling?
2. How do those effects vary depending on student gender and prior student achievement levels?

- Language arts: 4x4 no significant difference from traditional schedule (although A/B block > traditional)

- Science: 4x4 block scheduling generated a moderately strong main effect over traditional scheduling; AB block scheduling did not. This finding is a reversal of the block scheduling main effect found in the language arts analysis.

*Eva's Qs: I'm not sure how they accounted for growth or pre- to post-test… They have one sentence mentioning the students are matched in the ELA portion, but i'm not sure matched on what (prior achievement and gender, perhaps); and I think the ELA part only has 37 students with complete data? Science part i think has at least 100 across schedule groups. Matched using math performance to look at differences in Science outcome.*

**Slightly more detail**:

- The most popular method of block scheduling is the 4x4 semester plan, also known as "Accelerated Schedule" or "Copernican." In a 4x4 semester plan, students attend the same four 90-minute classes every day of the week. By attending each class every day, a student can complete four yearlong equivalent courses in one semester, although the amount of time spent in the course may be slightly less than in traditional scheduling (Queen, Algozzine, & Eddy, 1997). The plan offers teachers a manageable timetable, as they teach three classes with a daily planning period rather than five or six classes with a planning period every other day (Edwards, 1995).
- As for perceptions regarding the overall effectiveness of the 4x4 semester plan, parents have consistently perceived improvement in the academic and social outcomes of students participating in a block scheduling format (Eineder & Bishop, 1997; Thomas & O'Connell, 1997a). As for teachers, Edwards (1995) found that after one semester with a 4x4 schedule, they reported significant improvements in teaching effectiveness. Staunton (1997) found that teachers with five or more years of teaching in the 4x4 semester plan had significantly higher perceived ratings of assessment techniques than did teachers in a traditional scheduling environment. In a survey of four 4x4 block scheduling programs, Wilson and Stokes (2000) found that, overall and over time, students perceived block scheduling to be an effective approach, especially if they thought that teachers used a greater variety of teaching strategies in class. Thomas and O'Connell (1997b) found that students felt 4 x4 block classes offered fewer chances to cheat and increased fairness in grading. Additionally, Edwards (1995) found that a majority of students found it easier to focus on assignments and understand the lessons better.
- As for class size and classroom climate, two recent studies have found that teachers perceived an increase in class size with 4x4 semester plan scheduling (Limback & Jewell, 1998; Moore, Kirby, & Becton, 1997). However, Wilson and Stokes (2000) found that students perceived the 4x4 semester plan to offer a better instructional environment than in traditional scheduling (e.g., teachers get to know them better, greater variety of instruction). In addition, teachers perceived student/teacher relations to be better with 4x4 semester plan as there was more time for concentrated interactions (Eineder & Bishop, 1997; Skrobarcek et al., 1997; Thomas & O'Connell, 1997b). O' Neill (1995) also argued that discipline problems have dropped at many of the schools using block schedules because of this enhanced climate. These findings suggest that the 4x4 semester plan format may increase the number of students per class while creating a more productive learning environment.
- The 4x4 semester plan is designed to create a new and different teaching and learning experience for students and teachers. Staunton (1997) found that teachers with more years of experience were significantly more satisfied with instruction in 4x4 semester plan scheduling than in traditional scheduling. However, Baker and Bowman (2000) found that teachers with less experience were more likely to view block scheduling positively than were more experienced teachers, as they appeared more willing to make the necessary instructional changes. Using direct observations and in-depth interviews, Queen, Algozzine, and Eddy (1997), found that teachers appreciated the flexibility in classroom instruction, longer planning periods, greater course offerings, and more time for in-depth study that block scheduling provided.

- Outcome measures:
  - ELA: 9th grade language arts RIT score on the criterion-referenced levels test which was administered in the late fall and late spring of each year of this study. The levels test (Northwest Evaluation Association, 1997) is a well-established achievement test battery that allows school districts to measure growth in student learning from one year to the next

Stanley, A., & Gifford, L. J. (1998). The feasibility of 4x4 block scheduling in secondary schools: A review of the literature. *Paper presented at the Annual Meeting of the Mid-South Educational Research Association (27th, New Orleans, LA,November 4-6, 1998).*

**Focus**: Factors to consider in determining whether 4x4 is appropriate

**Key guiding question & finding**:
- Factors to consider in determining whether 4x4 is appropriate

**Slightly more detail**:
- Informal analyses - a paper presentation
- This paper reviews the literature on 4x4 block scheduling. Studies reveal that the advantages of such scheduling are simplicity, potential for greater student achievement, and reduced disciplinary referrals.
- Discipline is enhanced through this type of schedule because it decreases the number of times that students are moving in the halls between disciplined environments.
- The schedule promotes student achievement by allowing students to attend additional classes during their 4-year high school tenure, by encouraging more engaging learning activities, and by allowing students to concentrate narrowly on the four subjects taken each semester. This concentration may allow for better mastery of material, but it does not allow for the breadth of coverage found in traditional schedules.
- Consequently, the 4x4 block schedule should not be implemented in districts where test scores and strict adherence to state curriculum guides are considered sacred.
- Furthermore, student motivation plays a large part in the success or failure of the 4x4 block schedule; motivated students excel in such an environment, whereas poorly motivated students sometimes fall further behind than in traditional schedule environments.
- It is emphasized that careful planning in implementing 4x4 scheduling is essential to its success.

Harmston, M. T., Pliska, A., Ziomek, R. L., & Hackman, D. G. (2003). The relationship between schedule type and ACT assessment scores: A longitudinal study. *ACT Research Report Series (ACT-RR-2003-03).*

**Focus**: Relationship between high school schedule type and ACT performance

**Key guiding question & finding**: What is the relationship between high school schedule type and academic performance as measured by the ACT?
- The eight-period schools demonstrated a slight upward trend in mean ACT scores over time, regardless of content area.
- The eight-block schools demonstrated some variability in mean ACT scores, but increased little over time.
- After reaching a peak at or near the year of implementation, the 4x4 semester block schools demonstrated a generally declining trend in mean ACT scores across tests. With the exception of

Reading, mean ACT scores rebounded somewhat at the fourth year post implementation for the 4x4 semester block schools.

**Slightly more detail**:

- This study investigated trends in the mean ACT Assessment scores of 450 public high schools in Illinois and Iowa, according to how they scheduled classes.
- The schools continuously employed either a traditional eight-period daily schedule, 4x4 semester schedule, or an eight-block alternating day block schedule.
- Seven years of data were available for the blocked schools, representing 2 years pre implementation through 4 years post implementation.

iiri, L. (2019). *The effects of block scheduling and traditional scheduling on high school student achievement* [White paper]. Dartmouth College. https://digitalcommons.dartmouth.edu/cgi/viewcontent.cgi?article=1000&context=educ17whitepapers

**Focus**: Impact of block scheduling (4x4 and A/B) on high school student achievement, as measured by grade-point averages and standardized test score

**Key guiding question & finding**:

- Based on the findings of these 10 research studies, it is difficult to determine the effects of block and traditional scheduling on high school student achievement as measured by GPA and standardized test scores.
- A guarded conclusion would be that block scheduling is not associated with marked improvements in academic performance, regardless of whether those are measured by GPA or standardized test scores. While there is positive evidence, the effects are not large, and there is also negative and mixed evidence; thus, there appears to be little support from this research for changing to a block schedule in order to improve high school student achievement.
- Teachers and students have generally positive views of block scheduling

**Slightly more detail**:

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D., & Park, S. (2017). Lessons learned around the block: An analysis of research on the impact of block scheduling on science teaching and learning. In M. Shelley & M. Pehlivan (Eds), *Education research highlights in mathematics, science and technology* (pp. 132-138). ISRES Publishing.

**Focus**: Review of the literature on secondary school block scheduling

**Key guiding question & finding**:

- 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.

**Slightly more detail**:

- 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 measurable 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). 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).

Zelkowski, J. (2010). Secondary mathematics: Four credits, block schedules, continuous enrollment? What maximizes college readiness. *Mathematics Educator, 20*, 8-21.

**Focus**: This paper posits the position that if higher education and secondary schools wish to increase students' college readiness, specifically in mathematics and critical thinking skills, continuous enrollment in secondary mathematics is one avenue worth exploring as opposed to increasing mathematics graduation requirements only in terms of Carnegie credits

**Key guiding question & finding**:

**Slightly more detail**:

- This paper posits the position that if higher education and secondary schools wish to increase students' college readiness, specifically in mathematics and critical thinking skills, continuous enrollment in secondary mathematics is one avenue worth exploring as opposed to increasing mathematics graduation requirements only in terms of Carnegie credits. NAEP-HSTS 2005 and NELS:88 data indicate, respectively, non-continuous enrollment in secondary mathematics results in lower mathematics achievement and decreases the odds of completing a bachelor's degree. Nationally, schools following 4x4 block schedules (90-minute classes that meet daily for only one semester) were found to have mathematics achievement scores two thirds of one grade-level lower than schools following a 50-minute year-long mathematics courses. Typical college-bound students who do not take mathematics all four years of high school likely diminish their odds of bachelor degree completion by about 20%

Zepeda, S. J., & Mayers, R. S. (2006). An analysis of research on block scheduling. *Review of Educational Research, 76*, 137-170.

**Focus**: Review of 58 empirical studies on block scheduling in high school.

**Key guiding question & finding**: (note that "block" could mean alternating day A/B block, not just 4x4, note: 20 of the 58 studies examined the 4x4)
Three major themes across the five groups of studies emerged from this analysis.

- First, many of the research studies failed to report information that is customarily found in formal writing such as journal articles and convention papers.
- Second, the majority of the studies, with few exceptions, reported positive perceptions of block scheduling among teachers, students, and administrators.
- Third, the research presents mixed messages concerning the effect of block scheduling on teachers' instructional practices and on student achievement.

Within groups, data were inconsistent regarding whether teachers' practices changed, but teachers believed that staff development was necessary to teach in a block schedule. Block scheduling appeared to increase student grade point averages and improve school climate, but the results regarding its effects on standardized test scores and attendance were inconsistent.

**More detail**:

- **Teachers' instructional practices and perceptions of block scheduling**
  - The findings of the Group 1 studies were mixed. Teachers reported decreased student absenteeism, fewer student discipline problems, less class preparation, and decreased student anxiety. While teachers were generally positive about block scheduling, the relationship between teachers' experience and their perceptions of block is still unclear and mixed. While one study reports no relationship, another asserts that the more-experienced teachers were more positive about block scheduling. A third study concluded that less-experienced teachers were more positive about block than were teachers who were more experienced.

- The data on whether teachers changed their instructional practices were just as perplexing. Some studies reported teachers using more interactive teaching strategies, but others suggested that teachers did not change their teaching strategies or assessment practices after the implementation of a block schedule.

- **Change and block scheduling (i.e., what motivated the change to block scheduling & stakeholder responses to change)**
  - Teachers expressed needing appropriate PD
  - Trust is important
- **Effects of implementing block scheduling**
  - The findings of these studies were discussed across four areas: standardized test scores, grade point averages, discipline, and student attendance. Results indicate that although students in blocks tended to have higher grade point averages, the effect of block scheduling on test scores was inconsistent. Most studies assert that student discipline improved on a block schedule. While attendance rates were generally improved, several studies reported that block scheduling had no effects on attendance; and in others, teachers reported that maintaining discipline in the classroom was more stressful in the extended class periods provided in block scheduling.
  - Inconsistent findings either when looking at GPA or standardized test scores (some studies reported positive change, some reported negative change, as related to block schedules compared to traditional)
  - More consistent in discipline than in other areas: Evans et al. (2002), Khazzaka (1998), and Stader, (2001) reported that the number of disciplinary referrals decreased following the implementation of a block schedule. Duel (1999) concluded that student misconduct was reduced because of block scheduling. Less encouraging results came from Hamdy and Urich (1998), who reported teachers experiencing more difficulty in managing student behavior in classrooms. The three studies conducted by Queen et al. (1996, 1997, 1998), using interview data from teachers, students, parents, and administrators, reported that fewer than half of the students participating believed that discipline had improved on the block schedule. However, students and teachers had differing views on the effects of the 4x4 block on discipline. In all three studies (Queen et al., 1996, 1997, 1998) teachers reported using only 15% of their time on classroom management. However, students at the same research sites were less positive, with 52% of the students reporting discipline as being improved and 48% believing discipline remained constant or declined.
- **Effects of block scheduling on student learning**
  - The studies in Group 4 focused entirely on the question of whether block scheduling had any discernible effect on student learning. Predictably, most of these studies used quantitative methods and populations composed entirely of students. Only 5 studies in Group 4 identified the setting in which the research was conducted. As with the Group 3 studies, nearly all of the Group 4 studies were conducted in the eastern United States.
  - Four of these studies examined test scores and reported inconsistent results. In some studies, block-scheduled students scored higher on standardized tests than their traditionally scheduled counterparts; in other studies, block-scheduled students did not perform as well. While 1 study asserted that block-scheduled students significantly outperformed traditionally scheduled students across four content areas (English, biology, world history, and geometry), 2 other studies reported opposite results. Mixed results were also reported about grade point averages.
  - Increased AP examination scores by block-scheduled students also were reported by Evans et al. (2002). In contrast, Knight et al. (1999) and Snyder (1997) reported that AP examination scores dropped after implementation of a block schedule. Adding even more inconsistency to these results, Duel (1999) reported that block scheduling had no significant effect on standardized or AP examination scores.
- **Students' perceptions of block scheduling**

- Results indicate that students were generally positive toward block scheduling. High-achieving students who believed school to be important were more positive about block scheduling than were lower-achieving students. One study reported that block-scheduled students believed they were well prepared for college, and another study asserted that there was no relationship between the number of years a student spent in a block schedule and that student's perception of block scheduling.

For example, Knight, De Leon, and Smith (1999) used an ANCOVA to analyze quantitative data such as grade point averages, AP exam on Block Scheduling 149 scores, and focus group interviews to compare student achievement, instruction, and school climate in schools with block and traditional schedules. In a single HS. Snyder (1997) concluded that AP scores dropped slightly after the implementation of a block schedule. Knight et al. (1999) also reported lower AP exams scores. Increased AP examination scores by block-scheduled students also were reported by Evans et al. (2002). In contrast, Knight et al. (1999) and Snyder (1997) reported that AP examination scores dropped after implementation of a block schedule. Adding even more inconsistency to these results, Duel (1999) reported that block scheduling had no significant effect on standardized or AP examination scores

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