

The Nature of the Implementation at Suburban High School

In technical terms, this section could be entitled “limitations: threats to external validity.” It describes unique conditions at Suburban High School. Other schools that implement a semestered block schedule together with a *Standards*-based curriculum and adequate professional development and planning time will not necessarily get results similar to those that have been described here. The results at other schools might be better or worse because conditions unique to those sites will differ from conditions at Suburban High School. But the unique conditions at Suburban High School provide important lessons to be learned, so the current section provides new insights in addition to limitations.

Interaction of Community and Schedule

Historically, Suburban High School has been a high achieving school. There are many nearby college campuses, and the community puts a high value on education.

Traditionally, 90% of Suburban High School graduates enroll in 2- or 4-year colleges.

One teacher described the situation as follows:

We are a high-end community that values test scores, and math test scores especially. (Before adopting the block schedule) we used to have kids not take lunch in order to take more math and science. After we adopted the block schedule, students took more math. For some students, math became more enjoyable; for others, they wanted to take every mathematics course possible; and others had parents who said, “My child is going to take math every semester so they don’t forget it.”

Adoption of the semestered block schedule at Suburban High School led to a large increase in the number of mathematics classes students took. The school administration increased the minimum number of required classes from three to four, but the vast majority of students had already been taking four classes under the traditional schedule. Under the block schedule, most students increased their course taking to more than was required, enrolling in five or more mathematics courses over their high school career.

The risk that a different community might react very differently to implementation of a semestered block schedule is not merely a theoretical possibility. Gruber and Onwuegbuzie (2001) conducted a similar study in a very different community

in rural Georgia, and the results were vastly different. The nearest college to this high school was a 30-mile drive. Although a college preparatory track was available to students, many students on the college preparatory track have traditionally gone on to work or into the military after graduating from high school rather than enrolling in a 2- or 4-year college. Historically this high school required students to complete four units in language arts and three units each in math, science, and social studies in order to graduate. When they adopted a semestered block schedule in 1997-98, the requirements were not changed and the core curriculum was not modified. Teachers continued to use the traditional text they had used previously, covering the same content in each course despite the fewer hours available per course under a semestered block schedule. Also, new academic courses such as statistics or discrete mathematics were not introduced. Students had the option of enrolling in a larger number of academic classes under the semestered block schedule, but they generally did not. Instead, they enrolled in vocational classes, in forestry, or in two semesters of band. The major change in academic course-taking patterns was among students who failed a course. Under the prior scheduling system, those students would have been scheduled to re-register and complete that course again during summer school. Under the semestered block schedule they were able to complete a second enrollment in these same courses during the school year. As a result, the high school eventually eliminated its summer school program (personal communication, authors, April 20, 2002).

Under these conditions, Gruber and Onwuegbuzie (2001) noted that mathematics achievement appeared to suffer after the school adopted a semestered block schedule. Between the spring of 1997 and the spring of 2000, mathematics scores on the Georgia High School Graduation Test fell by a statistically significant .52 standard deviations. These data reflect only three years of the block scheduling, so this drop in tests scores may in part be due to an implementation dip (Busick & Inos, 1992; Fullan & Miles, 1992). Nonetheless, the large decrease is cause for serious concern.

Thus, in communities that differ in academic emphasis and parental education from Suburban High School, adopting a semestered block schedule may not lead to students enrolling in an increased number of mathematics courses. They may enroll in the same number of courses, with each course lasting fewer hours and covering less content than it had previously. As a result, achievement could suffer.

Schools adopting a semestered block schedule cannot presume that students will enroll in more academic courses in general, and more mathematics courses in particular, simply because more courses are available each year. Instead, existing courses need to be restructured to fit the new schedule. The core curriculum needs to be spread over a larger number of courses, and administrative policies need to be implemented to ensure that students enroll in them. New academic courses need to be created for students wishing to pursue advanced coursework beyond the core curriculum. These things were done at Suburban High School. Such policy changes are probably even more important for schools in less mathematics-oriented communities who are adopting a semestered block schedule.

Planning Time and Professional Development

It was the original intent of this study to investigate the impact of a semestered block schedule and a reform curriculum at a site where teachers had available a considerable amount of planning time and a considerable amount of professional development. This was the case at Suburban High School. It needs to be emphasized that the research literature provides strong evidence that without the planning time and professional development, positive results like those at Suburban High School are unlikely to be realized (Canady & Rettig, 1995; Kramer, 1997a).

Modifications to the IMP Curriculum

Teachers at Suburban High School did not implement the IMP curriculum as intended by its authors. Instead, they made three important changes.

First, they did not follow the IMP authors' recommendation that mathematics be taught in heterogeneous classes. Instead, they maintained three separate "levels" of IMP classes: Academic Assisted, College Preparatory, and Honors. Each level utilized the IMP curriculum, but completed modules at different rates. Over four Integrated Mathematics courses, students in lower-level classes completed less than four complete IMP textbooks. It is the belief of teachers at Suburban High School that despite completing fewer modules, students in the Academic Assisted classes studied much more advanced mathematics than they had done under the traditional program.

Previous research indicates that the approach to ability grouping taken at Suburban High School may be a good one. Gamoran, et al. (1997) studied "transition" courses in California and New York that were designed introduce lower ability students to college preparatory mathematics, often by teaching the college preparatory content over a longer period of time. They reported that the programs were generally successful. Further, two of the "transition" classes originally in their study had used IMP, but according to the authors the IMP classes were dropped from the study because initial examination of results showed them to be outliers in instruction and achievement. When contacted to provide details about the IMP classes, the authors indicated that test scores in those classes had been sufficiently high so that they skewed the overall results of the study (personal communication, Smithson, 2001).

Despite the support provided by Gamoran et al.'s (1997) article for using IMP as was done at Suburban High School, the authors of IMP have made a strong case for utilizing the curriculum in heterogeneous classes (Alper, et al., 1997). Whether doing so would have affected the results at Suburban High School cannot be answered by the data provided by the current study.

A second change made to the IMP curriculum at Suburban High School may have affected achievement on the Advanced Placement calculus exams. The school continued to use a pre-calculus course, to be taken after completing IMP and before taking calculus. It was the intent of IMP's authors that students could take calculus immediately after completing the fourth IMP textbook (Green, 2000), or even simultaneously with the fourth textbook (Fendel, Resek, Fraser, & Alper, 1997). Teachers at Suburban High School debated whether completing all four IMP textbooks was sufficient preparation for Calculus. One teacher commented that before studying calculus, students who had completed the traditional core sequence of algebra 1, geometry, and algebra 2 needed an intervening course to reflect on the math they'd learned and see why things are working, to "see the forest for the trees." Similarly, she felt that after completing the four IMP texts, students still needed that intervening "reflection" course before enrolling in calculus. Other teachers disagreed with the need for such a course. In the end, they decided to keep the pre-calculus course, which utilized the UCSMP text *Precalculus and Discrete Mathematics* (Perissini, et al., 1992). In part, this decision was based on the fact that they could afford to do so, given the extra number of courses students could take under the semestered block schedule. The combination of four IMP courses, followed by pre-calculus, followed by a two-semester sequence of Calculus AB and Calculus BC has certainly achieved spectacular success at Suburban High School. Whether similar success could have been achieved without the intervening pre-calculus course cannot be answered by the current study.

A third modification to the IMP curriculum by the teachers at Suburban High School was the use of complementary materials. This modification is less important than the other two, because the materials were not used extensively for students in the First and Second Reform cohorts. Mathematics teachers at Suburban High School described the development of the complementary materials as follows. For the first two years they were utilizing the IMP curriculum, teachers sometimes made their own work sheets and used traditional problems as warm ups. In the summer of 1999, teachers responded to the concern of some parents who wanted to see more traditional texts coming home by more formally integrating into their program the algebra 1, geometry, and algebra 2 textbooks that had been in use before the adoption of IMP. They prepared a list of specific problems from the algebra 1, geometry, and algebra 2 textbooks that are matched to specific IMP modules and could be used for enrichment or reinforcement, as needed. Today, these specific problems are sometimes used as homework assignments and

sometimes used in class. Because students in the First Reform cohort were entering eleventh grade and students in the Second Reform cohort were entering tenth grade at the time the formal complementary materials were prepared, the materials did not have as much impact on students completing the Algebra Achievement test as they have had on students in subsequent cohorts. Nonetheless, it is possible that achievement results would have been different had these complementary problems not been utilized. Huntley, et al. (2000) provided data indicating that similar complementary materials may have had a positive achievement effect on students utilizing the Core-Plus curriculum.

Visual Mathematics

Most students in either the Traditional cohort or the Reform cohorts had utilized the curriculum Visual Mathematics (Foreman & Bennett, 1991) in middle school. Teachers at Suburban High School believed that the middle school curriculum had a very positive impact on student achievement. The Visual Mathematics curriculum is also an unusually good match to the problem-centered approach used by IMP. Further, there is some indication in the data from Test 3 that previously low-achieving students who had used both the Visual Mathematics curriculum in middle school and the IMP curriculum in high school showed large improvements in their ability to solve an extended, open-ended algebra problem, but that either curriculum alone was insufficient. Thus, it is possible that results would be different at a high school whose students had experienced more traditional instruction in middle school.

Use of the Visual Mathematics curriculum may have affected not only students' preparation for using IMP, but also the readiness of teachers to implement the IMP curriculum. Before adopting IMP, high school teachers had worked extensively with

middle school teachers who had implemented the *Visual Mathematics* curriculum, attending professional development that supported use of the Visual Mathematics curriculum for three consecutive summers. As one Suburban High School mathematics teacher put it, “IMP was easy for most of us to adopt since we were already far along the change continuum by the time we had to make a choice.” Thus, it is possible that previous experience with the *Visual Mathematics* middle school curriculum enabled the high school teachers to teach the IMP curriculum more effectively. Results might have been different had this not been the case.

A Strong Grass Roots Leader

Mrs. Sullivan played a key role in changing the mathematics program at Suburban High School. Since 1984, she had served jointly as mathematics supervisor for the school district and as high school mathematics department chair. In that position, she had been involved in hiring new mathematics teachers at both the middle school and the high school and had chosen candidates whose teaching philosophy was broadly compatible with what was eventually outlined in the NCTM *Curriculum and Evaluation Standards* (NCTM, 1989). She arranged high quality professional development over many consecutive summers, first for the *Visual Mathematics* curriculum and then for the IMP curriculum, and convinced both middle school and high school mathematics teachers to attend the professional development. To build support for the new curricula, she organized parent education nights, and rallied key stakeholders within the community. At various times during the early years IMP was being utilized, she made arrangements to have a reduced teaching load so that she could mentor teachers learning to utilize the new curriculum.

Since leaving Suburban High School in 1999, Mrs. Sullivan has worked with other school districts implementing IMP, Core-Plus, and other curricula designed to implement the *Curriculum and Evaluation Standards* (NCTM, 1989). She believes that those schools who were most successful also had strong grassroots leadership supporting the new program. A Suburban High School IMP mathematics teacher who took a leave of absence from Suburban High School to mentor other schools using new curricula, confirms this opinion. Commenting, based on her experience at Suburban High School and elsewhere about what is need to make a program successful, she noted:

First of all, a grass roots leader in the math department who has a vision and a drive to do the best thing for students regardless of the criticism that inevitably comes from those who do not wish to change. I say grass roots because I think there has to be a leader within the department, a department head or a strong teacher. If it comes from upper administration as a whole it does not seem to work, at least not well or quickly. (Mrs. Sullivan) was the impetus for the change; at first in the middle school, and then as we prepared for Block she led us through the change to IMP.

Unusually Strong Mathematics Teachers

The mathematics teachers at Suburban High School were unusual in a number of ways. They were proactive in designing a mathematics program they believed would benefit their students. Almost all the mathematics teachers at the high school in the mid-1990s attended professional development to learn about the new middle school curriculum their future students were using, even though they themselves would not be teaching that curriculum. When the high school decided to adopt a block schedule, they searched for a curriculum they thought would match the schedule. Upon identifying the IMP curriculum, they then adapted it to fit the needs of their school and their community. In addition to making the changes described in the previous section, teachers at the school believe they were the first in the nation to adopt IMP school-wide, rather than as

an alternative program operating in parallel with a traditional curriculum. Since adopting IMP, most teachers have attended four summers of intensive training in use of the curriculum. The teachers have continued to make changes to their courses, gradually adding modules to course syllabi as they have become more familiar with the program, and adapting and refining the complementary materials they use with the program. It is unclear whether the combination of a semestered block schedule and a Standards-based curriculum could have been successful at a school with a less assertive and professional group of mathematics teachers.

Collegial Mathematics Department

Both the principal and mathematics teachers at Suburban High School emphasized the fact that a major factor in the mathematics department's success was the ability of teachers in the department to work well together. Other schools trying to replicate the results of the current study may need to pay attention not only to developing the skills of individual mathematics teachers, but also to developing a collegial atmosphere in which mathematics teachers can build on one another's strengths.

Time to Prepare for the Change

After the high school administration decided to adopt a semestered block schedule, and before it was implemented, teachers at the school were given a year to prepare for the change. One teacher described the importance of this planning year as follows:

We were given a year to prepare for the change and our department, with Mrs. Sullivan's direction, did do our homework. Every in-service day was spent collaborating about what do we want our students to be able to do mathematically and how are we going to get them there. Then we looked at the curriculum that was available and chose IMP.

Without a year to plan, teachers at Suburban High School may not have been able to make the changes that appear to have contributed to the success of their mathematics program under a semestered block schedule.

Elements of Community Support

With strong support from the district superintendent and assistant superintendent, Mrs. Sullivan had implemented the Visual Mathematics curriculum at the middle school, beginning in 1991-92. Subsequently, both the superintendent and assistant superintendent left the district, so most of the impetus for change at the high school came from Mrs. Sullivan and other teachers there. By the time they began to consider IMP, a series of parent nights and similar events had organized a degree of community support for the Visual Mathematics curriculum. Further, mathematics test scores had improved at the middle school, and some community members perceived the improvement as being due to the use of Visual Mathematics. Finally, when the high school faculty was considering how to adapt their mathematics curriculum to meet the needs of a semestered block schedule, Mrs. Sullivan arranged a meeting with a group of mathematics professors from nearby colleges who were also parents of children attending the high school. This group strongly endorsed the adoption of an integrated curriculum, and it was a member of this college group who first suggested that the high school consider utilizing IMP. The support of an influential group of local parents with strong education credentials helped counter vocal opposition to the new program that was expressed by other groups within the community.