

Synergy of IMP and the Semestered Block Schedule

The current study was designed to investigate the joint effects of a semestered block schedule and the IMP curriculum, at a site where sufficient planning time and professional development were available to make it likely these changes would be implemented effectively. Results of the study cannot be attributed to either the curriculum or schedule alone. Rather, it is the impact of both together that appears to have achieved positive results.

Regarding a semestered block schedule, there is considerable evidence based on anecdotes, observations, and surveys that successful implementation requires changes in teaching style, changes in curriculum, and changes in the support given to teachers. The majority of achievement research to date has been conducted at sites where few if any of these changes have been made. The result has usually been equivocal or negative effects on mathematics achievement.

This is the first study that investigated mathematics achievement a site at which all of the research-recommended changes had been implemented. While the mathematics teachers at Suburban High School were engaged in extensive planning to adapt their program to the needs of the semestered block schedule even before they decided to utilize IMP, the adoption of IMP made it much easier for them to modify course content and instruction in a way that fit the new schedule. One possible reason so much other research has been conducted at sites that did not make the recommended changes when adopting a semestered block schedule is that, absent a reform curriculum, such changes may be difficult or impossible to implement.

The result of the implementation was a very positive effect on student mathematics learning. Students in the Reform cohorts had a somewhat different, but generally more flexible and stronger profile of algebra knowledge than did students in the Traditional cohort. Students had more opportunity to study probability and statistics, to study other mathematics beyond the core curriculum, and to enroll in Advanced Placement classes. The two-semester course in Calculus BC that was possible under a semestered block schedule was particularly successful, as measured by student performance on the AP Calculus BC examination.

Regarding IMP, there has been considerable controversy about the worth of that curriculum. In particular, Wu (2000) and others have accused the curriculum of inadequately preparing students to study advanced mathematics. They have labeled the program as providing insufficient drill, insufficient support for the teacher in guiding students to abstraction and generalization of ideas, and insufficient emphasis on mathematical precision. In contrast, the authors view the curriculum's problem-centered approach as a likely vehicle for empowering students as mathematical thinkers with a deep understanding of underlying concepts (Alper, et al., 1997). In particular, the curriculum might help to overcome the problem of "inert knowledge" described by Bransford, et al. (1989), and thus might better prepare students for future learning.

As implemented at Suburban High School, there was some limited evidence that the curriculum's lack of drill resulted in less automatic or fluent operation on procedures, as Wu (2000) predicted. However, the advantage students in the Traditional cohort had in performing procedural operations appeared to be "inert." When symbol manipulation

problems were presented in anything other than the standard format, students in the Reform cohorts were as likely to solve them as were students in the Traditional cohort.

Students who used the IMP curriculum had higher achievement on items requiring formulation of mathematical models, interpretation of tables and graphs, and cooperative work with a partner to solve an extended, open-ended problem involving linear equations. It should be noted that the success of learning algebra under IMP may have been due in part to the longer time blocks under a semestered block schedule, which could perhaps support IMP's style of investigations.

Students who had utilized the IMP curriculum seemed particularly well prepared for studying calculus. After studying Calculus BC under a two-semester format they scored significantly higher on the Advanced Calculus BC exam than had students who used a traditional curriculum and studied Calculus BC under the same format. Although alternate explanations cannot be ruled out, this result is consistent with the hypothesis that algebra concepts might be less "inert" if they are learned using IMP materials instead of a traditional curriculum.

As can be seen from the previous paragraph, this study provides direct evidence regarding the validity of concerns about IMP's ability to provide students a firm technical foundation for pursuit of more advanced work in mathematics or science (Wu, 2000). The experience at Suburban High School provides strong evidence that students who complete the IMP curriculum can have an excellent technical foundation to pursue advanced study in mathematics or science.

It should be noted, however, that after completing the IMP sequence students at Suburban High School did complete a pre-calculus course before enrolling in calculus,

just as students using the traditional core sequence had done. Some teachers at Suburban High School believed students would not have been as successful at calculus without the intervening course. Given that the IMP sequence uses four texts, versus three for the traditional sequence, without the extra courses available under a semestered block schedule it would have been difficult or impossible for many students to have completed IMP, then completed pre-calculus, and still have had time for calculus. Whether forgoing the pre-calculus course would have negatively affected students' achievement in calculus cannot be determined from the current study.

Mrs. Sullivan, the former mathematics supervisor at Suburban High School noted that one of the goals teachers hoped to achieve by adopting a reform curriculum was “to get our mainstream kids, not just our top level kids, to enroll in advanced mathematics courses.” There is some research evidence that utilizing the IMP curriculum can indeed motivate students who wouldn't otherwise do so to study advanced mathematics (Webb, in press). While the IMP curriculum may have motivated some students to enroll in advanced courses, the semestered block schedule provided extra opportunities for them to do so. Again, the current study cannot separate the effects of the two interventions. Together, they did accomplish the goal of increasing mainstream students' participation in advanced mathematics classes. Overall, the proportion of students enrolling in at least one advanced course beyond the core curriculum increased from 48% in traditional cohorts to 58% in the First Reform cohort. This was true despite the fact that students in the First Reform cohort had to complete four core courses before they were able to study more advanced mathematics, compared to three core courses for students in the traditional cohorts. Further, the proportion of students studying Advanced Placement

classes swelled, due mainly to the large number of students interested in Advanced Placements statistics. About 13% of the students in the First Reform cohort enrolled in the Advanced Placement statistics course.

According to one study, the success of teachers at Suburban High School in encouraging mainstream students to study advanced mathematics courses may have had a strong impact on their students' future. An investigation of longitudinal data from the High School and Beyond survey reported that one of the strongest predictors of whether an individual would successfully earn a bachelors is the highest level of mathematics he or she completed in high school. 62% of students who completed trigonometry in high school went on to completed a bachelor's degree, versus only 39.5% of students whose highest course was algebra 2 (Adelman, 1999).