SERP Strategic Education Research Partnership

Oakland and San Francisco create course pathways through Common Core Mathematics

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How has the Common Core changed the equation on acceleration?

The Common Core State Standards for Mathematics (CCSS-M) set rigorous standards for each of grades 6, 7 and 8. Topics previously taught in Algebra I begin in grade 8. About half of the traditional Algebra I course (linear functions and equations, systems of linear equations) is now included in the 8th grade content standards, along with serious work in statistics and geometry. The other half of the Algebra I topics (e.g., polynomials, quadratic equation) are in the CCSS-M high school content standards.

The critical content now incorporated into 8th grade math poses a challenge for districts: before the CCSS-M were adopted in most states, many students completed Algebra I by the end of 8th grade by skipping a course. With the adoption of CCSS-M, skipping is no longer feasible; every grade has essential content. Yet many parents believe that completing Algebra I by the end of 8th grade is what their children must do to be competitive when they apply to college. Furthermore, parents often see acceleration as a way to place their children with good teachers and good students, protecting them from the influence of students who do not study or do homework.

With the new standards. student progressing through the CCSS-M courses would reach college eligibility (Algebra I, Geometry, and Algebra II) at the end of 11th grade. The student could take an additional mathematics course as a senior (presumably Pre-Calculus or Statistics), or choose not to take a math course in their senior year. But AP Calculus would not be a possibility in high school unless Pre-Calculus (Math Analysis) could be completed by the end of 11th grade. Because all grades have essential content, acceleration can only be accomplished through *compression:* studying two years of content in one year, or three years in two.

It is worth noting that the Mathematics Association of America recommends against high schools teaching Calculus. College faculty surveyed by ACT rate topics from middle school and Algebra I as more important than advanced topics for college preparation. Nonetheless, admissions offices award an extra grade point for AP courses, making AP Calculus a valuable accomplishment when applying for highly selective colleges. School districts will therefore be pressed to make it possible.

In fact, in recent years many districts have touted increases in 8th grade algebra enrollment and have adopted policies to encourage or even require it—despite ample data showing many, or even the majority, of enrollees were unprepared for the course.

In other subjects like English or Science, AP is not accessed through acceleration. Why is mathematics different? In the U.S. other subjects are perceived as having depth and breadth as well as length (length is the sequence of topics). Ambitious students in other subjects can go deeper and wider without having to go faster; they can write longer, deeper papers, read more and in greater depth, and speak more eruditely in discussions. But in mathematics, the popular American perception is that the ambitious can only go faster through the sequence. Topics have no depth or breadth.

The management of the mathematics curriculum based on this perception of one-dimensional content leads to a curriculum that can be characterized as a "mile wide and inch deep." The U.S. curriculum has been superficial by design. Ambitious students were given nowhere to go but on to the next topic. Our top students have been disadvantaged compared to students from high performing countries by having nothing better than racing through a superficial curriculum.

Research comparing the U.S. mathematics performance to high performing countries[1] has identified the "mile wide, inch deep" curriculum as the main culprit. In some ways, acceleration policies in school mathematics have been a symptom of the underlying curriculum disease.

The CCSS-M have made major shifts toward a more coherent and focused curriculum--a curriculum with depth as well as length. It is now possible for ambitious students to go deeper into each topic, not just faster through a superficial treatment of the topics. It is time to take a new look at acceleration policies and make changes that will promise better results for students—especially more students well prepared for college mathematics without remediation.

SERP collaboration with two districts in the formulation of new policies and programs

SERP has been working with two school districts, Oakland Unified School District and San Francisco Unified School District, to evaluate extant policies and practices and formulate new policies based on the CCSS-M shifts that promise to work better for students. This work has culminated in school board adoptions of new policies in both districts.

A team of mathematics officials has led the work from both districts facilitated by SERP staff. When the pronoun "we" is used in this article, it refers to the districts' staffs and the SERP staff collectively.[2] We own this work separately and in common.

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[1] For example, McKnight, C. C. (1987). *The Underachieving Curriculum: Assessing US School Mathematics from an International Perspective. A National Report on the Second International Mathematics Study*. Stipes Publishing Co., 10-12 Chester St., Champaign, IL 61820.

[2] Who we are: From OUSD: Phil Tucher, Estelle Woodbury, Geetha Lakshminarayanan and Barbara Schreve; from SFUSD: Jim Ryan, Ho Nguyen, Angela Torres, Elizabeth Barnes Hull; from SERP: Harold Asturias and Phil Daro. With admiration and gratitude for the deputy superintendents, superintendents and school boards that had the courage to act.

The district teams met with each other and SERP staff periodically to solve the tough political and pragmatic problems surrounding the design of a new policy and the crucial explanations of the design that would make sense to parents, students and school boards. Ideas were traded and tested, language and graphics vetted and revised. Stories were swapped that helped to muster the courage to negotiate the designs through the respective districts leadership. And finally, each district team was on hand to congratulate the other at Board adoption. The collaboration is extending into the challenges of implementation.

Both districts have and have had a strong commitment to social justice. Leadership in both cases has been deeply disturbed by the persistence of achievement gaps in mathematics and especially high rates of low mathematics performance among the intended beneficiaries of social justice work.

The arrival of the CCSS-M coincided with the recruitment of dynamic teams of mathematics leaders in both districts. In different ways, these teams were working intensively to support teachers in transition to Common Core at the same time that they were engaged in district policy work and collaborating with school leadership initiatives. In the midst of this important instructional improvement work, the need for new acceleration policies became urgent.

The acceleration issues arrive fully loaded with sensitivities and political dangers. The interactions of school mathematic departments with parents and other community members are easily fraught with irritability. Parents are at the doors of the school board campaigning for what they think districts should do to protect their children from adverse fates and position them for good lives. The reluctance of bureaucracies to risk change in such situations—particularly controversial change—is well known. Fortunately, both districts had coherent support from the mathematics teams to top district leaders, rooted in a shared passion for social justice. Remarkably, mathematics leaders whose primary expertise is instruction and capacity development among mathematics teachers were able to accomplish a major political feat—one that will change the conditions that shape how and who teachers teach, and how and what students learn. While these stories of the design and eventual adoption are interesting and in some respects important, this article will focus on the problems, solutions and designs that can be of immediate use to other districts and states.

Problem 1: The devil you know is better than the devil you don't

The first problem was rooted in the past: the status quo usually feels more comfortable politically than change to the unknown. To make change attractive, the status quo has to be unattractive. When the status quo is hidden behind high 8th grade enrollments in Algebra I—an outcome than many celebrate—the political will to change is weak.

Solution: Shift the goal from enrollment in Algebra I to completion of college readiness.

One always feels the unseen threats lurking in the prospect of change. We realized that the unseen had to be revealed; others needed to understand what was happening to students after they were enrolled in Algebra I. The consequences were buried in the data from transcripts showing course sequences from 7th grade through high school.

To frame the relevance of these data and to guide the design of course pathways, we shifted the goal. The explicit goal shift is this: from enrollment in Algebra I to completion of college eligibility.

The data tell a compelling story;[3] one that makes it uncomfortable to defend the status quo. For example, the most common course sequence in the transcripts of one of our districts was as follows: grade 8: Algebra I, grade 9: repeat Algebra I, grade 10: Geometry, grade 11: Algebra II, grade 12: repeat Algebra II. The next most common sequence also involved repeating algebra I. The third most common sequence repeated algebra I three times! Only 5% took the presumably normal sequence running from Algebra I in 8th grade through Calculus in 12th grade. Perhaps even more damning was the fact that not a single sequence was followed by as many as 10% of the students. Of the many, many sequences, few were defensible as a desirable pathway.

This situation was far from unique to our urban districts. A 2013 study of transcripts across a large random sample of California school districts found similar situations to be typical.[4] The data spoke: something had to be done.

Problem 2: Transition to the Common Core

The second problem is one belonging to the future: transitioning to the Common Core posed a major organizational challenge. We needed to draw attention to the opportunity the shift to the CCSS-M offered to make many overdue changes. Among these was the revision of course syllabi and sequences to conform to the new college eligibility requirements.

College eligibility in California is de facto defined by the University of California in its influential "a to g" course requirements (see U.C. Admissions website). These a to g requirements include 3 courses that incorporate the content specified in the CCSS-M (under requirement "c"; mathematics). This is the CCSS revision of what had been Algebra I, Advanced Algebra (Algebra II) and Geometry. It allows for a traditional or integrated configuration of this content.

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[3] The data analyses that informed our collaboration were conducted with Bechtel Foundation support by Neal Findelstein, West Ed, and Michelle Reininger, Stanford University Center for Education Policy Analysis.

[4] College Bound in middle school & high school? *How Math Course Sequences Matter;* Neal Finkelstein, Anthony Fong, Juliet Tiffany-Morales, Patrick Shields, Min Huang; Center for the Study of Teaching, West Ed, **www.cftl.org**; 2013; funded by grants from the Bechtel Foundation and the Noyce Foundation.

Solution: Define new courses and course sequences for implementation of the Common Core

Four years of high school are available for a student to take the three courses needed for college eligibility. What is the smartest way to spend these years? It depends on the student's goals, commitment and preparedness. Recognition of these differences among students raises fears of tracking. While not as bad as tracking itself, fear of tracking can harm students by inhibiting adults from working on the very real problem of variation among students that schools must address. Denial is never the first step in solving a problem.

Unlike the insidious tracking of the past, the new approach to differences among students' focuses on preparing all of them for college, leading different pathways to a common goal. Oakland and San Francisco designed three pathways (course sequences) that each led to college eligibility. These pathways are offered as options for students rather than as placements. In this respect, the options parallel the way students choose programs in college. Like college, courses have announced pre-requisites and qualifications, but the school does not "place" students, the students opt for a sequence.

In a nutshell, the options are designed for students with different ambitions and commitment:

- The regular option follows the pace of the Common Core leading to college eligibility by the end of grade 11 and the opportunity to take an additional mathematics course in the senior year. The 11th grade course will complete the content of the CCSS-M at a reasonable pace, on par with international competitors. Students who opt for this sequence will be eligible to take credit bearing college mathematics courses when they get to college.

- The accelerated option compresses two years into one to enable taking AP Calculus in high school. There are two options for compression: one in middle school and one in high school. The recommended compression is in high school: compressing Algebra II and Pre-Calculus. Students at this point are more mature than they are in middle school, and more aware of the consequences of their choices. Students with STEM ambitions or competing for highly selective colleges will accept the extra work of a faster paced course.

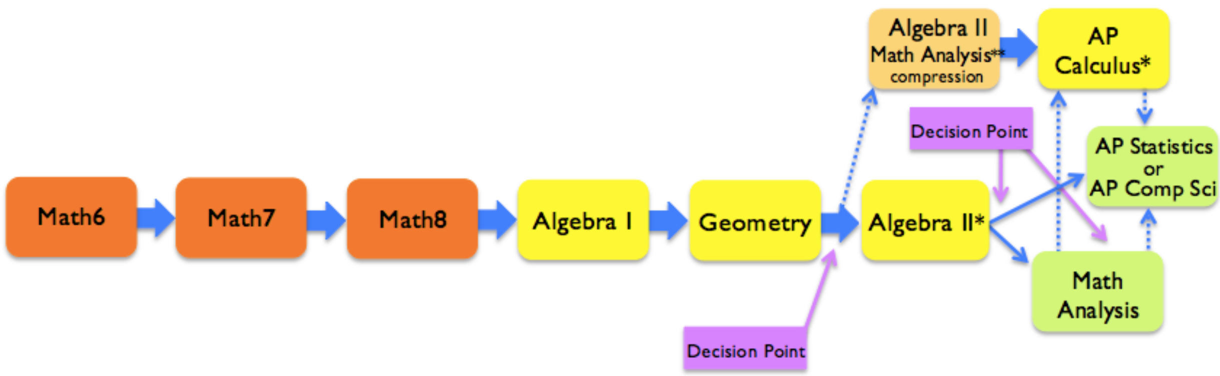
- The third option is for students who want to go to college, but who need help to get through the mathematics requirements. These students will complete the required courses on time with extra support. If successful, they will be eligible to enroll in credit bearing college courses without remediation.

Here is the actual explanation from the Oakland Unified School District as presented to and adopted by their Board of Education (*Common Core State Standards (CCSS) and the*

Mathematics Course Sequence Options, prepared by staff of Oakland Unified School District, December 5, 2013):

Recommendation 1: All schools offer to all students a Core Course Sequence aligned to CCSS-M, as shown below.

Figure 1.1: The Core Course Sequence



We recommended that the Board of Education approve the Core Course Sequence as shown above. This Core Course Sequence ensures a solid middle-grades foundation and prepares each student to graduate from high school prepared for college mathematics. For students who would like to complete an AP math course, the Core Course Sequence allows them to do so, with at least one way to compress core courses during their high school years specifically in preparation for AP Calculus. This sequence ensures that all students can have equal access to the same high-quality learning experiences.

One major difference between this course sequence and the typical course sequence of the last decade in California is the inclusion of significant new course content in the middle grade years. The Core Course Sequence includes an eighth grade math course with important mathematics content standards that middle school students were previously not taught. The three-year CCSS-M middle school course sequence – Math 6, Math 7, and Math 8 – includes many topics previously not taught until high school, including topics from algebra, geometry, and statistics. For example, the standards that defined an Algebra I course under the previous California standards are now divided between the CCSS Math 8 course and the CCSS Algebra I course, making Math 8 an integral part of mathematical development through secondary school.

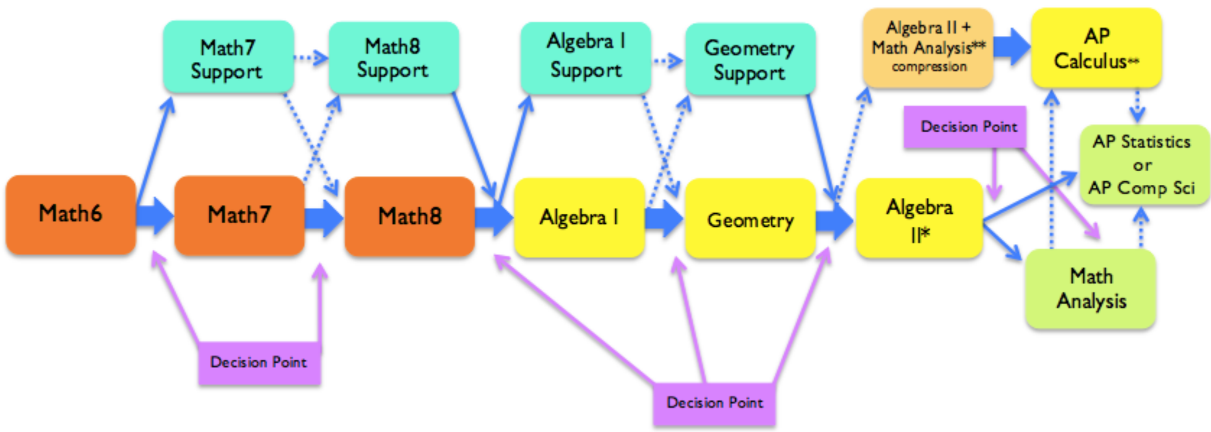
Recommendation 2: All middle and high schools offer additional courses to supplement the Core Course Sequence, as needed. These courses serve the purpose of:

A) providing additional support for students to succeed in the Core Course Sequence.
B) providing challenge for students to leverage the Core Course Sequence in preparation for academic study in STEM-related fields.

Recommendations 2A and 2B, below, allow for additional course sequence options that augment the Core Course Sequence in ways that provide each student the appropriate opportunities to meet their aspirations, needs and interests. The additional options supplement the Core Course Sequence to meet diverse student needs, while ensuring all students move through a sequence of courses that is rigorous, aligned, and a solid preparation for college, career, and community.

Recommendation 2A: All schools offer supplementary Support Course Options that middle and high school students can take to ensure their success in the Core Course Sequence, as needed. (See Figure 2A)

Figure 2A: Core Course Sequence with Support Course Options



It is important that each student is supported to succeed in the Core Course Sequence, as this is the mathematics that prepares students for success beyond high school. Recognizing that some students may need additional support in order to succeed, school sites must implement a system of support, including offering daily support courses for students and their families to choose for varying periods of time.

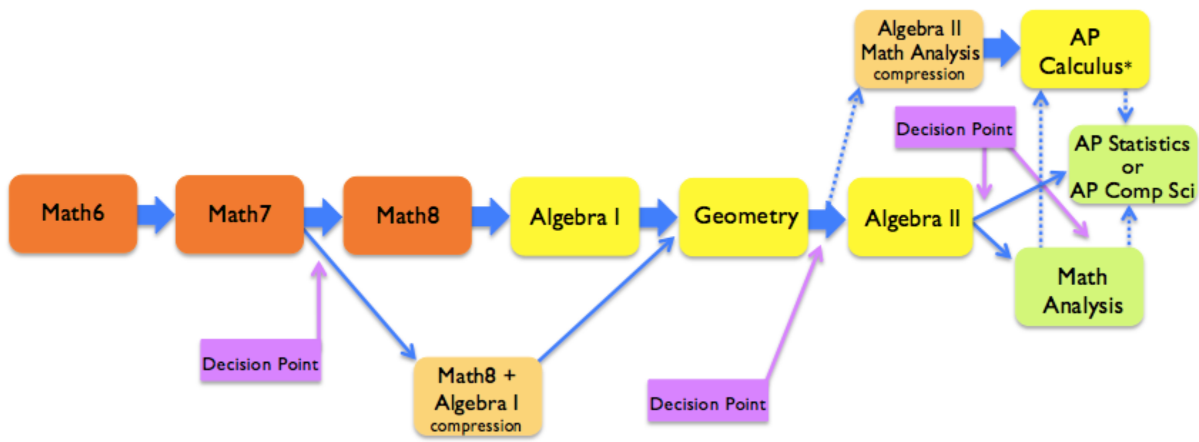
Students in support courses are expected to meet the rigorous standards of the Core Course Sequence. The additional support is intended to provide genuine access to the cognitively demanding work of the Core Course Sequence. To ensure that these courses are coherently embedded within the course sequence, the school should follow these guidelines:

- Support courses are taught by a math teacher leader or an experienced math teacher who has demonstrated success with diverse learners.
- Pedagogy and curriculum in support courses are student-centered and focus on conceptual understanding, including opportunities to engage with a variety of mathematical tools. An on-line component, or "blended learning", is highly recommended.

- Teachers of support courses have collaboration opportunities both within their school's math team and also with other support course teachers.
- Whenever possible, students taking support courses will be taught by the same teacher of the grade-level core course they are enrolled in.

Recommendation 2B: All schools offer a Challenge Course Option, as needed. At middle school, this option takes the form of Math 8 and Algebra I compression, offered in the 8th grade. At high school, this option takes the form of Algebra II and Math Analysis compression, or simultaneous course completion (i.e., "doubling up") of two other high school math courses (e.g., Algebra I and Geometry). (See Figure 2B)

Figure 2B: Core Course Sequence with Challenge Course Options



The Challenge Course Options, with opportunities in middle school and then again in high school for course compression, are designed specifically for students who demonstrate a particular interest in and commitment to a very high level of mathematical challenge. In the past, the structure of the previous California standards allowed middle school students who were seeking to challenge themselves to "skip" a year of math coursework and accelerate into a more advanced course. In contrast, the mathematics content within CCSS-M builds consistently upon itself; it is structured so that no course is "skippable." The Challenge Course Options instead allow students seeking significant challenge to take on learning two years of mathematical content compressed into one academic year. Pursuing this option enables students to graduate from high school prepared for specialized studies in STEM in selective university settings.

We recommend a thoughtful and thorough process to determine students' commitment to, and preparation for such accelerated coursework, particularly in the middle grades. Analysis of academic achievement data suggests that only a small portion of students in middle school (no more than 10%) will be ready for this Challenge Course Option. How will students be admitted into this Option? The process we recommend uses multiple measures selected by the district to guide the decision-making conversation between the school and family. School site and math teacher leaders will lead family interviews, but the ultimate decision to "opt in" belongs to the student and family. The use of a family-school contract agreement will clarify the expectations for enrollment in the Challenge Course Option, and performance requirements for students to stay in the program will be clearly documented and discussed.

Problem 3: Parents want their children in 8^{th} grade Algebra I

The third problem is rooted in the present. Parents see middle school as charged with fatefulness for their children. At the same time, they feel their own control over their children's fates diminishing rapidly. Are they headed to college? Will it be a good college? Are they going to be influenced by other students whose values are not ours? Are they going to get involved with drugs and drop out? They are uncertain about the signs.

One sign that all is well is the placement of their student in classes with good students vs. placement in classes with students who do not study or do their homework. While many educators think the parental pressure for 8^{th} grade algebra comes solely from the "gifted" parents, much of it also comes from parents anxious about the downside of their children's fate.

Districts are and should be concerned with parental anxieties and aspirations. They cannot simply take away the important reassurance that comes with enrollment in Algebra I in 8^{th} grade, no matter how empty it will turn out to be for many, if not most. They must offer new assurances.

Solution: Clear pathways to college with appealing options for acceleration in high school.

Seventh or eighth grade should not be a point at which admission to elite universities such as Harvard or Stanford is removed from the realm of possibility. Yet, under current college admissions policies, an extra grade point is awarded for AP courses (to remove any disincentive for taking tougher courses). For highly selective colleges, this extra point can make the difference, so students competing for these selective slots are encouraged to load up on AP courses. In mathematics, unlike the other subjects, this requires acceleration.

Oakland and San Francisco now offer acceleration in high school, where it has fewer negative consequences. This alternative makes more sense for three reasons: students are more mature, the fundamentals of algebra from 8^{th} and 9^{th} grade are more important than advanced topics and should get more (not less) time and attention, and it postpones fateful sorting of students so they have better chance to grow up and dedicate themselves to their aspirations.

The CCSS-M provide an opportunity for school in the U.S. education system to offer a world-class mathematics education to all students. The openness of the U.S. public school system to political influence, while a protective factor in some respects, can create a barrier to even the most important reform efforts. These two districts and the school boards that oversee them provide a model of success from which others can learn.