



May 2014

Governance Brief

Governing to the Core, Issue 6

Pathway Options for High School Mathematics

What are the two pathways?

Among the challenges that California’s K-12 school districts face in implementing the Common Core math standards is the question of the structure and sequence of math courses. There are two basic approaches for providing students with a sequence of math courses through which they can master the Common Core math standards. One option is the traditional pathway, with which most students, teachers and parents are familiar because it follows the sequence of courses currently provided by a majority of high schools.

Year 1 Algebra 1 > Year 2 Geometry > Year 3 Algebra 2

The second option is an integrated pathway, which blends standards from two or more domains in each of a three-course sequence. Table 1 below summarizes the number of standards covered in each of the five domains for both pathways¹ and highlights significant differences between the two pathways. For example, the traditional geometry class addresses 46 geometry standards. In the integrated math courses, 13, 26, and 8 geometry standards are addressed in years one, two and three respectively. Both pathways are designed to ensure students master all the math standards by Grade 12. Both pathways can include compacted curriculum, where students cover the content at an accelerated rate so they have more opportunities for additional math courses in Grades 11 and 12.

Table 1

Standards	Traditional			Integrated		
	Algebra 1	Geometry	Algebra 2	Math I	Math II	Math III
Number & Quantity	6		5	3	8	2
Algebra	22		18	17	13	17
Functions	24		20	19	15	19
Geometry		46	1	13	26	8
Statistics & Probability	10	11	9	10	11	9

Note: Standards may be repeated in both sequences.

Rationale for the integrated pathway—why switch?

Table 2

Top-performing countries on TIMSS 2011	Grade 4 Math	Grade 8 Math
Singapore	606	611
Korea, Rep. of	605	613
Hong-Kong-CHN	602	586
Chinese Taipei-CHN	591	609
Japan	585	570
United States	541	509

Countries that significantly outperformed the U.S. in mathematics in Grades 4 and 8, as measured by the Trends in International Mathematics and Science Study (TIMSS) 2011 (See Table 2), use a math sequence similar to the integrated pathway.² Course sequence may not be a causal factor in these results; there is no research on the extent to which an integrated pathway influences student performance on international assessments.³ However, there is a small but emerging body of evidence of an achievement benefit in the U.S. to the integrated approach. Researchers from the University of Missouri found that high school students enrolled in integrated math courses earned higher scores on a standardized mathematics test than those who did not.⁴

How would adopting an integrated pathway affect districts?

Vertical alignment with other schools

High schools moving to integrated mathematics will need to think about how the change will affect incoming students as well as their graduates. High school districts often have more than one elementary feeder district. Effective communication and outreach will be necessary to ensure that feeder districts understand how incoming students who have completed traditional or integrated middle school math courses will be placed into the high school's math program.

Alignment with colleges

High schools will have to ensure that integrated math courses satisfy college entrance requirements. Guidelines for the University of California (UC) admission requirements clearly state that combinations of integrated math, algebra, geometry and other courses can also satisfy the "c" subject requirement.⁵

High school districts will also have to review whether any junior high advanced or accelerated math courses will fulfill the high school district's requirements. This will have implications for students fulfilling UC math requirements, and the ability for students to take more advanced math courses in high school. For example, if an eighth-grade student completes an Algebra 1 course (that the high school recognizes as equivalent to freshman Algebra 1) prior to freshman year of high school, that student might be able to complete the equivalent of Algebra 2 or Integrated Mathematics III by the end of their sophomore year. That student would then have greater opportunity for more advanced math courses in Grades 11 and 12 – a pathway college bound students might wish to pursue to increase their chances of being accepted into the UC system.

Regardless of the math course sequence districts choose, traditional or integrated, the Common Core standards are changing the content of high school math courses. As a result, a University of California FAQ states that within the next few years UC will require a re-review of all a-g approved math courses to demonstrate compliance with the university's mathematics course criteria. The exact timeframe for when this will occur has not been determined.⁶ Boards will want to ensure that, whichever course sequence is selected for high school mathematics, the Common Core aligned course content provides the level of rigor that UC requires.

Teacher professional development

Choosing an integrated mathematics pathway has implications for teachers. Switching to an integrated pathway may require districts to make changes in teacher assignments. New professional development will also be necessary. A study of integrated math implementation in a junior high school recommended a full week of pre-service training with ongoing support.⁷ The change might also impact teacher recruitment; the district may find it difficult to recruit math teachers with experience teaching in an integrated pathway. At the same time, the change can

be well-perceived by math teachers. One study found that 83% of teachers involved in implementation preferred to continue with the integrated mathematics curriculum.⁸

Instructional materials

Districts will need to acquire instructional materials as well. While integrated mathematics is gaining attention because of the Common Core standards, the idea is not new. New York has been using integrated math since the early 1970s.⁹ The integrated pathway option was noted as a possible course sequence in California's Mathematics Framework, first adopted in 1997. As a result, publishers of mathematics textbooks have been providing integrated math materials for many years. The University of Missouri is currently conducting a long-range study of the use of mathematics textbooks in traditional and integrated pathways.¹⁰

Assessments

Finally, these changes will affect assessment practices. At the state level, it is not completely clear whether Smarter Balanced Assessment Consortium (SBAC) assessments will provide opportunities for high schools to choose assessments aligned to specific standards based on their course pathways. Locally, district benchmark assessments would have to be developed to align to the new pathway.

How many districts in California are moving to integrated mathematics?

A fall 2013 survey of more than 800 districts, conducted by the Consortium for the Implementation of the Common Core State Standards, had four interesting findings.¹¹

With regard to which mathematics course sequence districts had chosen:

- 32% of districts had decided to switch to integrated math courses
- 26% of districts had elected to maintain the traditional pathway
- 42% of districts had not decided

With regard to offering accelerated options in middle school:

- 30% were not offering accelerated options

- 24% indicated they would offer a compressed sixth and seventh grade Common Core math course so that students are ready for Algebra 1 in eighth grade

Multi-year implementation

Districts will want to ensure that students have access to a coherent sequence of math courses as they progress through the grades. One common approach to address this concern is to shift to the integrated pathway over a four year period, adopting Mathematics I the in first year, Mathematics II in the second year, and so on, implementing the senior year integrated math courses in year four.¹²

How should board members approach the question of integrated mathematics?

Because boards approve short- and long-range goals and budgets, they play an important role in balancing the scope and speed of change. Boards may want to hear from stakeholders, including teachers, parents and the business community, and then work with the superintendent and staff to clarify how the decision will impact the district. To what extent will either pathway impact:

- Student placement including district transfer students?
- Student achievement?
- Other district changes already in progress or planned?
- Math teachers now and in the future, including teacher recruitment and retention, assignment, and professional development?
- The development of local curricula, selection of instructional materials, and assessments?

After exploring these questions, boards must ultimately balance their governing roles:

- Representative: What does our community want the district to do?
- Instrumental: What must the district do to meet the requirements and the spirit of the law?
- Fiduciary: What can the district do, given our current and projected capacity?
- Educational: What should the district do based on the professional recommendations of staff?

Endnotes

- 1 Common Core Standards Initiative. (2010). Mathematics appendix E: Higher mathematics pathways chart. <http://www.cde.ca.gov/ci/ma/cf/documents/aug2013apxehighermath.pdf>
- 2 American Institutes of Research. (2009). Informing grades 1-6 mathematics standards development: What can be learned from high-performing Hong, Kong, Korea and Singapore? Washington, DC: Leinwand, S., Ginsburg, A. & Decker, K. <http://ccsesa.org/special-projects/common-core-standards-communication-tools/>
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- 4 Tarr, J., Grouws, D., Chávez, O. and Soria V. (2013). The effects of content organization and curriculum implementation on students' mathematic learning in second-year high school courses. *Journal for Research in Mathematics Education*, 44, 683-729
- 5 <http://www.ucop.edu/agguide/a-g-requirements/c-mathematics/index.html> Accessed on April 16, 2014.
- 6 <http://www.ucop.edu/agguide/a-g-requirements/c-mathematics/faq/index.html> Accessed on April 28, 2014.
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- 8 Northwest Regional Education Laboratory. (1994). *Integrated Curriculum*. Kathy Lake
- 9 National Council of Teachers of Mathematics (2001) *Integrated Mathematics after 25 years*. Washington, D.C.: Lynn, R. <http://www.nctm.org/resources/content.aspx?id=1700>
- 10 <http://cosmic.missouri.edu/>
- 11 Consortium for the Implementation of the Common Core State Standards. (2013). *Common core state standards survey: State-wide summary of results*.
- 12 Curriculum Leadership Institute. *Traditional math course vs integrated math courses: How to decide?* <http://cliweb.org/?p=2285> Accessed on April 8, 2014.