Mathematics Course-Taking in California's Middle and High Schools: Patterns and Implications

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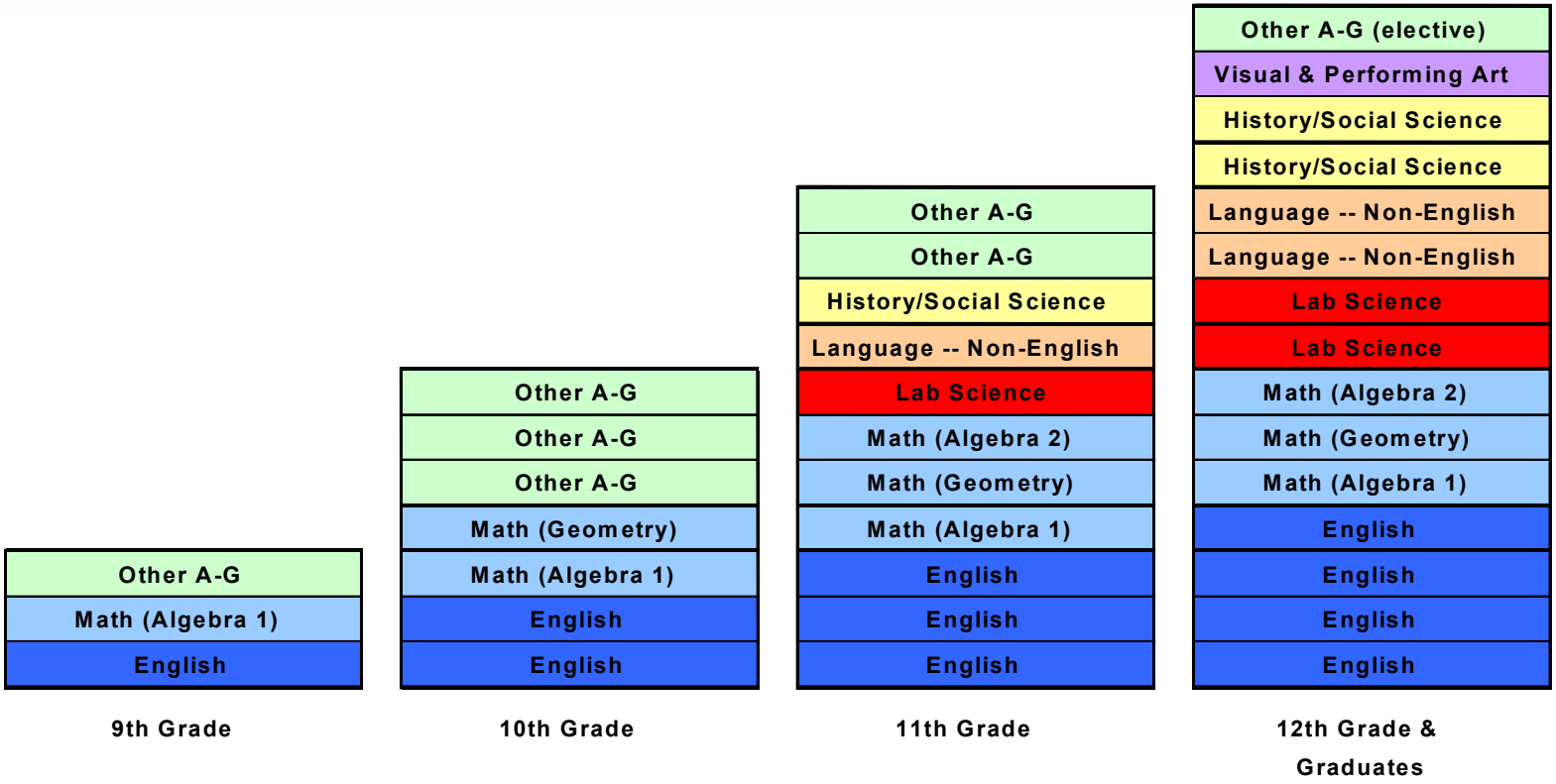
“A-G” Course Requirements



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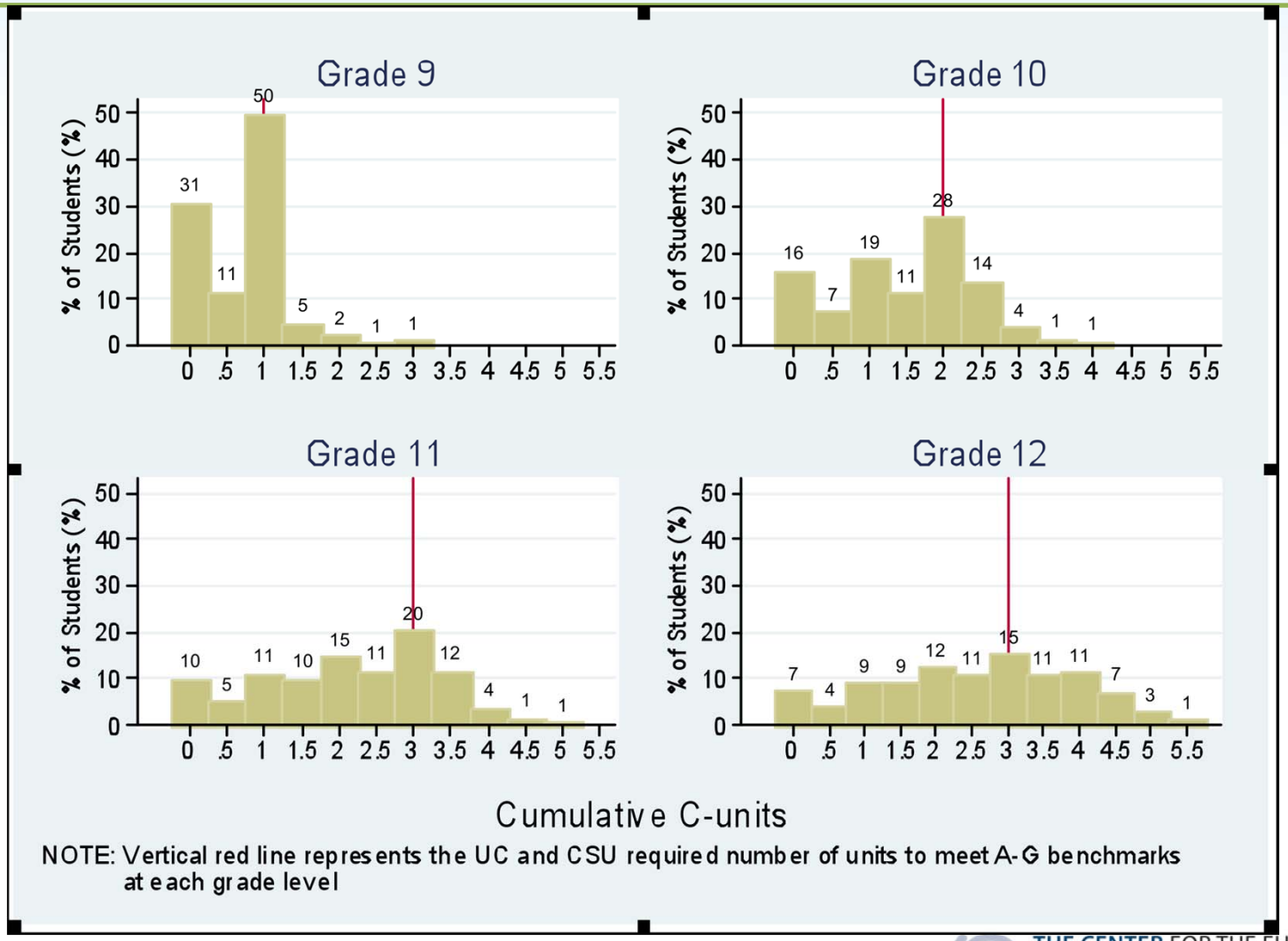
Cumulative Units Completed in Math, by Grade Level



NOTE: Vertical red line represents the UC and CSU required number of units to meet A-G benchmarks at each grade level

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Background

- New research funded with a generous grant from the S.D. Bechtel Jr. Foundation and the Noyce Foundation
- Interest in supporting students to become proficient in math and science
- Longitudinal data is needed to understand the pathways that students take in their math and science coursework

Dataset

- Links students over time
- Students were 7th graders in 2004/05, and expected to be 12th graders in 2009/10
- In this analysis we only include students who were enrolled in the same district in each of the years from 2004/05 to 2009/10 (stable students)
- Dataset contains over 24,000 students in 24 districts
- Wide variety of districts based on geographic location, size, urbanicity, student demographics, academic achievement, etc.

Dataset

	Percent of 7th grade students in the analytic sample	Percent of 7th grade students in the state in 2004/05
Student Ethnicity		
African American	8.86%	8.15%
American Indian	0.55%	0.84%
Asian	15.33%	8.15%
Filipino	1.81%	2.56%
Hispanic	44.65%	46.27%
Pacific Islander	0.62%	0.63%
Unknown/Multiple	0.25%	1.39%
White	27.92%	32.01%
Low Economic Status	50.57%	49.90%
Special Education	8.52%	10.55%
English Learner	20.42%	20.75%

Finding 1: Math performance in grade 7 is predictive of high-school math course-taking.

Students who perform well in grade-7 math are likely to take more-advanced courses in high school compared to those who struggle with middle-school math.

Finding 2: The majority of students who achieved at least Proficient on their math CSTs are those who took algebra 1 in grade 8, geometry in grade 9, and algebra 2 in grade 10.

In general, however, this accelerated pathway does not support students who are not proficient in math in grade 7.

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Finding 3: Many students repeat algebra, but few repeaters achieve proficiency on their second attempt.

Roughly one third of students in the study sample repeated algebra 1 at some point between grades 7 and 12 — repetition that yielded discouraging results.

Finding 4: Districts are keenly aware of poor student performance in mathematics but less aware of course-taking patterns.

Staff in each of three districts interviewed for the study were already keenly aware of how their students had been performing in math; each of the three districts had already undertaken efforts to boost math outcomes.

Finding 5: Districts feel great urgency to improve algebra outcomes.

Interviewees from each of the three districts we visited described experiencing great pressure to improve mathematics achievement and described district efforts to address shortcomings.

Math Course-taking Analysis

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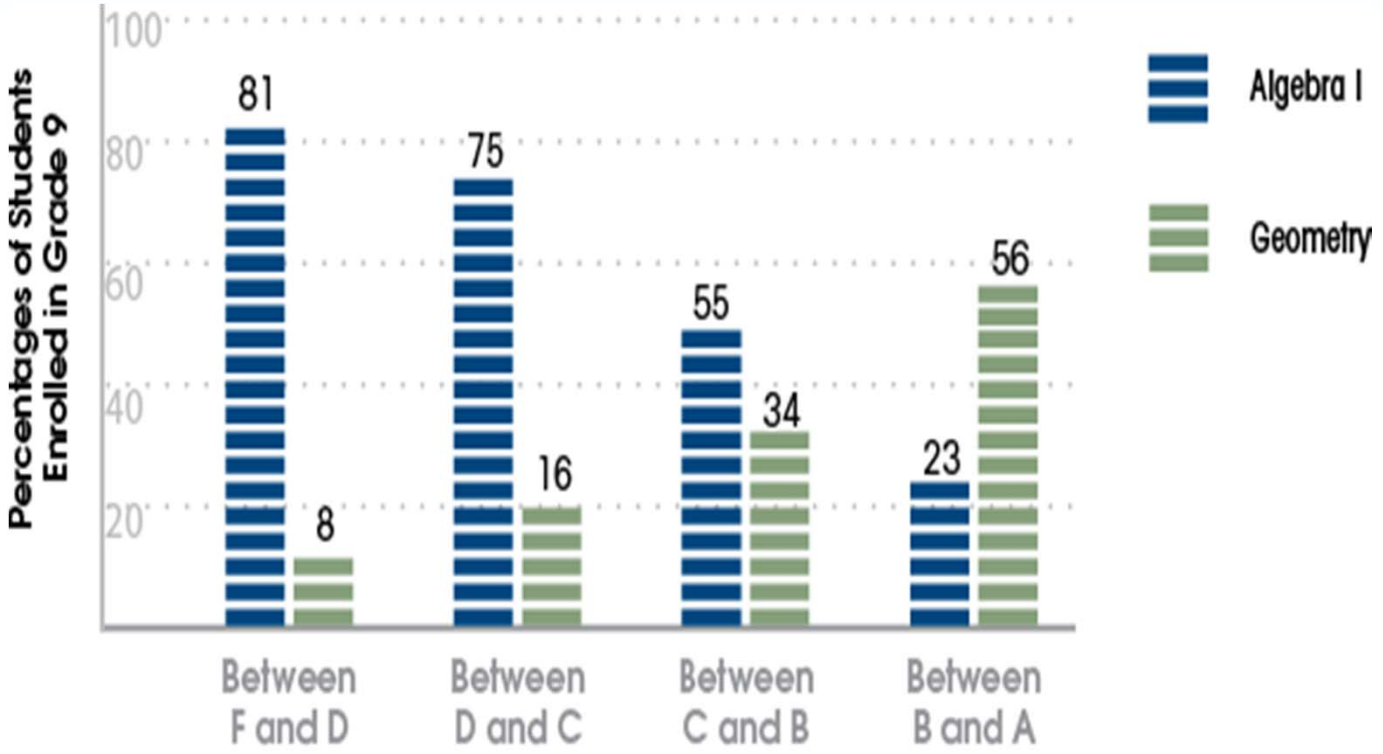
Students' 7th grade math performance and subsequent 9th grade math-course enrollment



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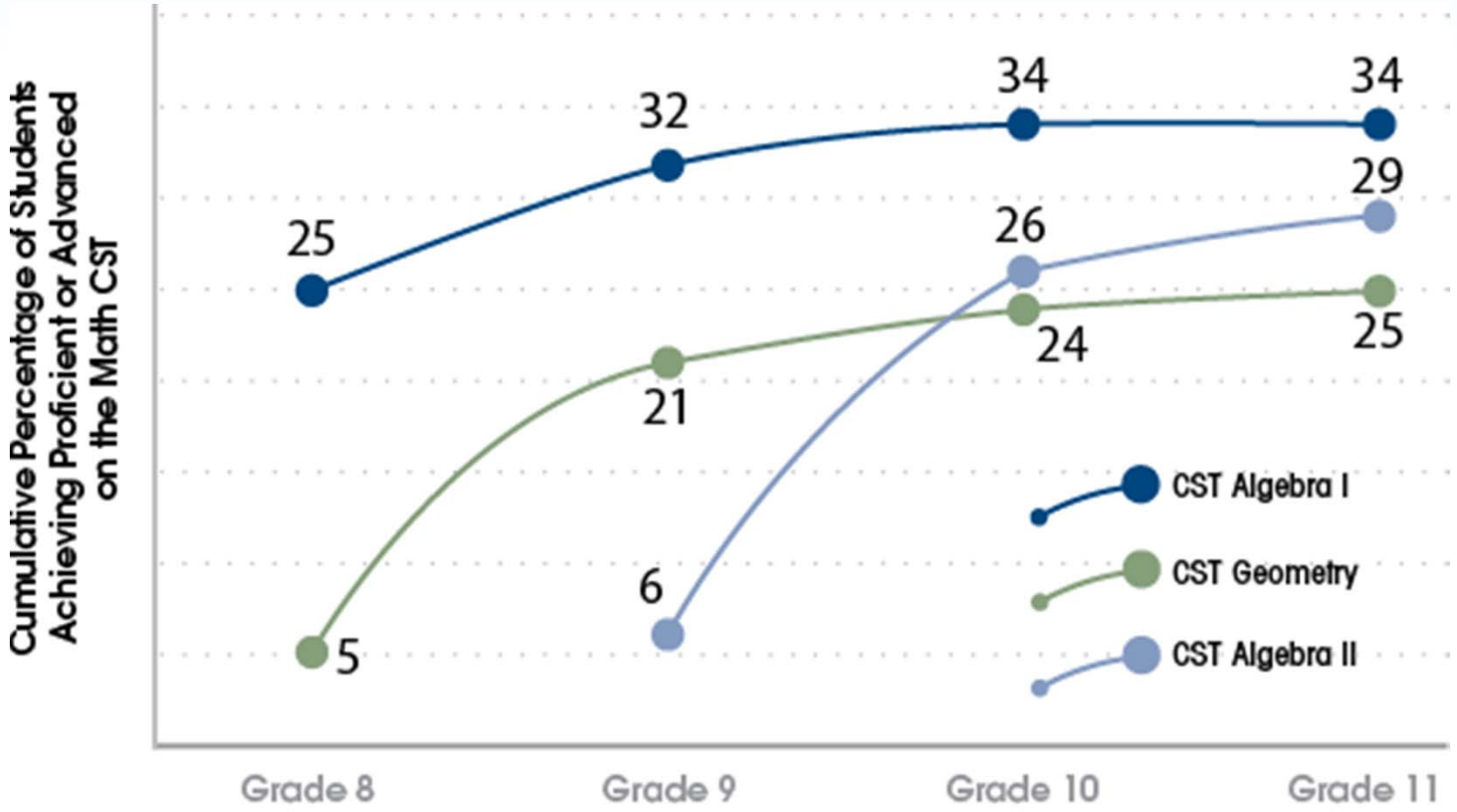
Cumulative percentage of students achieving Proficient or Advanced on the math CST



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Math Course Rankings

Rank	Description
0	Independent Study
1	Basic Math (Math 7, Foundations, CAHSEE Prep, etc)
2	Pre-Algebra
3	Algebra
4	Geometry
5	Intermediate Algebra/Algebra II
6	Statistics/Finite/Discrete
7	Pre-calculus/Math Analysis/Trigonometry
8	Calculus
9	Linear Algebra

Math Trajectory

13457 -

Math course-taking patterns

	Sequence	Percentage of Students	Cumulative Percentage of Students
1.	134578	3.30	3.30
2.	134576	2.52	5.82
3.	234578	2.47	8.30
4.	23345-	2.08	10.38
5.	234577	1.68	12.06
6.	13457-	1.65	13.72
7.	234576	1.64	15.35
8.	13345-	1.48	16.84
9.	133457	1.46	18.30
10.	233457	1.44	19.73
11.	345786	1.43	21.17
12.	12345-	1.35	22.52
13.	334578	1.34	23.86
14.	345788	1.28	25.14
15.	23457-	1.27	26.41
16.	233455	1.18	27.59
17.	133455	1.08	28.67
18.	334576	0.92	29.59
19.	22345-	0.87	30.46
20.	12344-	0.78	31.24

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Repeating and passing rates among students within the sample

	Percentage
Algebra 1 pass rate in grade 8 among students who first took algebra 1 in grade 8	62.69
Algebra 1 pass rate in grade 9 among students who first took algebra 1 in grade 9	37.60
Proportion of the sample who took algebra 1 in grades 8 and 9	22.72
Proportion of the sample who took algebra 1 in grades 9 and 10	13.49
Proportion of the sample who took algebra 1 in grades 8, 9, and 10	4.43
Proportion of the sample who ever repeated algebra 1	33.57
Proportion of the sample who ever repeated geometry	15.96
Proportion of the sample who ever repeated algebra 2	10.17
Proportion of the sample who ever repeated algebra 1, geometry, or algebra 2	49.70
Proportion of the sample who ever passed algebra 2	44.24
Proportion of the sample who did not take a math course in grade 12	30.18

District-level Variation

District A: Math course-taking patterns

Trajectory	Frequency	Percent	Cumulative Percent
13457.	243	8.35	8.35
12345.	227	7.80	16.15
123344	152	5.22	21.37
12344.	134	4.60	25.98
134578	117	4.02	30.00
123454	105	3.61	33.61
123455	103	3.54	37.15
123444	100	3.44	40.58
13345.	83	2.85	43.44
134576	78	2.68	46.12
13455.	61	2.10	48.21
123457	57	1.96	50.17
1234.4	54	1.86	52.03
123345	48	1.65	53.68
134577	42	1.44	55.12
123445	36	1.24	56.36
12334.	35	1.20	57.56
133457	33	1.13	58.69
133444	32	1.10	59.79
133455	32	1.10	60.89

District B: Math course-taking patterns

Trajectory	Frequency	Percent	Cumulative Percent
133.44	112	5.56	5.56
134578	71	3.53	9.09
133457	68	3.38	12.47
133455	67	3.33	15.80
13345.	60	2.98	18.78
134.44	50	2.48	21.26
133445	45	2.24	23.50
133.43	44	2.19	25.68
134576	42	2.09	27.77
1.3578	39	1.94	29.71
13457.	38	1.89	31.59
13.457	37	1.84	33.43
134577	37	1.84	35.27
133.34	34	1.69	36.96
133444	32	1.59	38.55
134.45	32	1.59	40.14
13.578	31	1.54	41.68
133.33	29	1.44	43.12
1.3455	27	1.34	44.46
133.45	27	1.34	45.80

District C: Math course-taking patterns

Trajectory	Frequency	Percent	Cumulative Percent
133455	101	8.24	8.24
13345.	71	5.80	14.04
133345	67	5.47	19.51
134578	61	4.98	24.49
133457	51	4.16	28.65
13457.	30	2.45	31.10
134576	30	2.45	33.55
133445	29	2.37	35.92
13334.	26	2.12	38.04
1334.4	24	1.96	40.00
345788	22	1.80	41.80
1333.4	20	1.63	43.43
133346	19	1.55	44.98
1334..	18	1.47	46.45
1334.5	18	1.47	47.92
13455.	18	1.47	49.39
345786	17	1.39	50.78
13344.	15	1.22	52.00
134557	15	1.22	53.22
133578	14	1.14	54.37

Considerations for Further Action

When students take algebra 1 (that is, in which grade) is less important than whether students are _ready_ to take it.

The decision about when a student should take algebra 1 (e.g., grade 8? grade 9?) should be based on a careful review of the student's record to date in mastering pre-algebraic concepts, measured in several ways, including prior-year CST scores, teacher recommendations, results from district-administered benchmark assessments, and consultation with parents and counselors.

Considerations for Further Action

Having students repeat algebra 1 is generally not an effective strategy for supporting students who struggle in their first attempt at algebra.

There should be a careful review of district and school-level instructional support strategies in algebra, coupled with an examination of individual students' particular learning needs, using diagnostic and benchmark assessments and teacher recommendations.

Considerations for Further Action

Current course sequences are typically not cost effective.

The common pattern of students repeating courses without succeeding has direct implications for how resources are being used, and how they might be allocated differently.

Math matters in elementary school

The large variation in students' grade-7 math performance suggests that more work must be done at the elementary level to prepare students for success in middle-grade math. The implementation of CCSSM in early grades can enable substantial revisions in instructional approaches.

Considerations for CCSSM Implementation

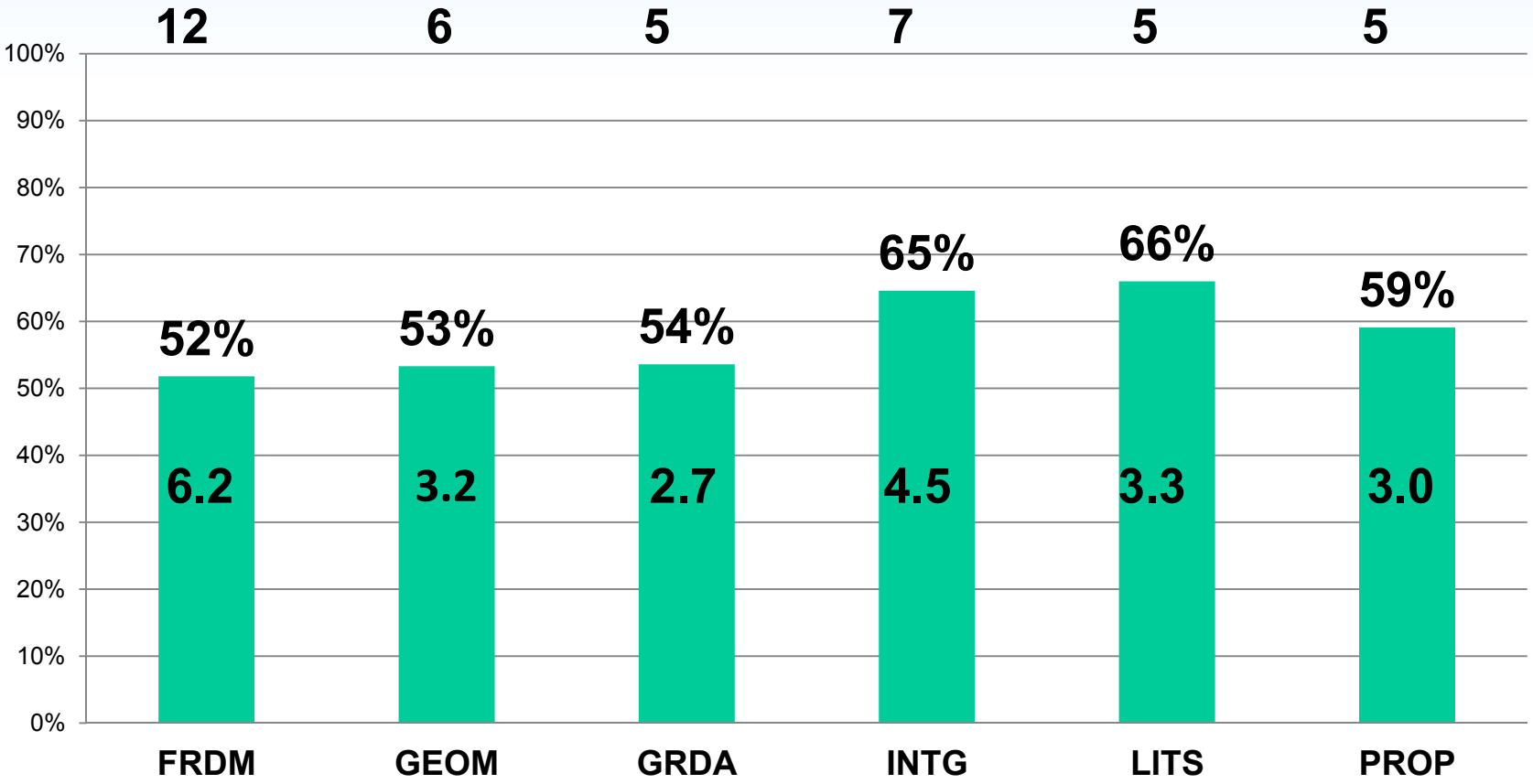
The CCSSM Algebra 1 and Mathematics 1 courses build on the CCSSM for Grade 8, and are correspondingly more advanced than the previous expectations for Algebra 1.

Some recalibration of course sequencing will be needed given the additional content.

Decisions to accelerate students while in middle school should be carefully considered.

Solid evidence of mastery of prerequisite standards should be required; diagnostic testing can help identify strengths and challenges in particular areas of math content.

Example: average percent of correct in each sub-content strand in the MDTP Pre-Algebra readiness test, grade 6 (2010/2011)



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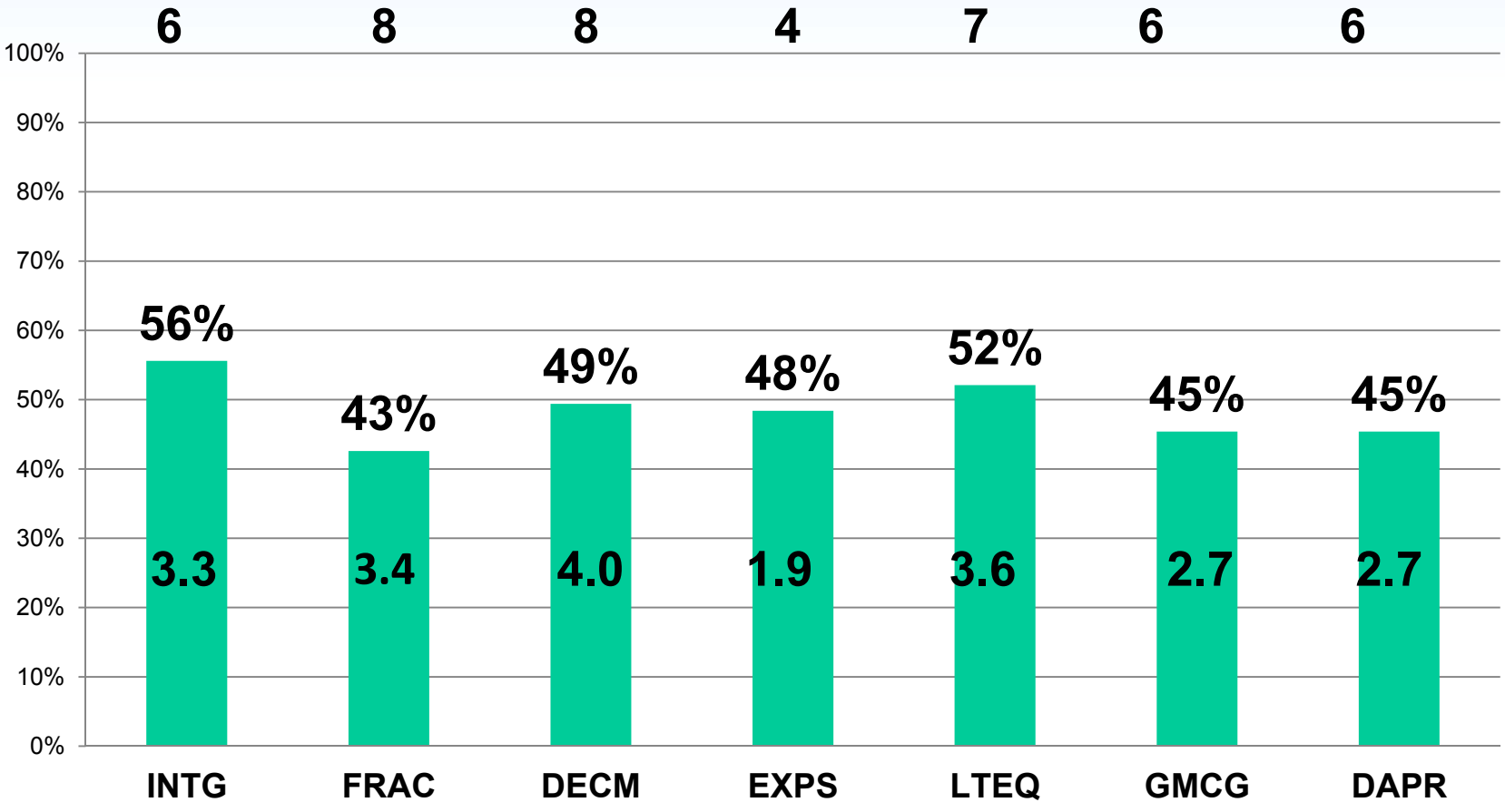
Example: Average percent of correct in each sub-content strand on the MDTP Algebra readiness test, grade 7 (2010/2011)



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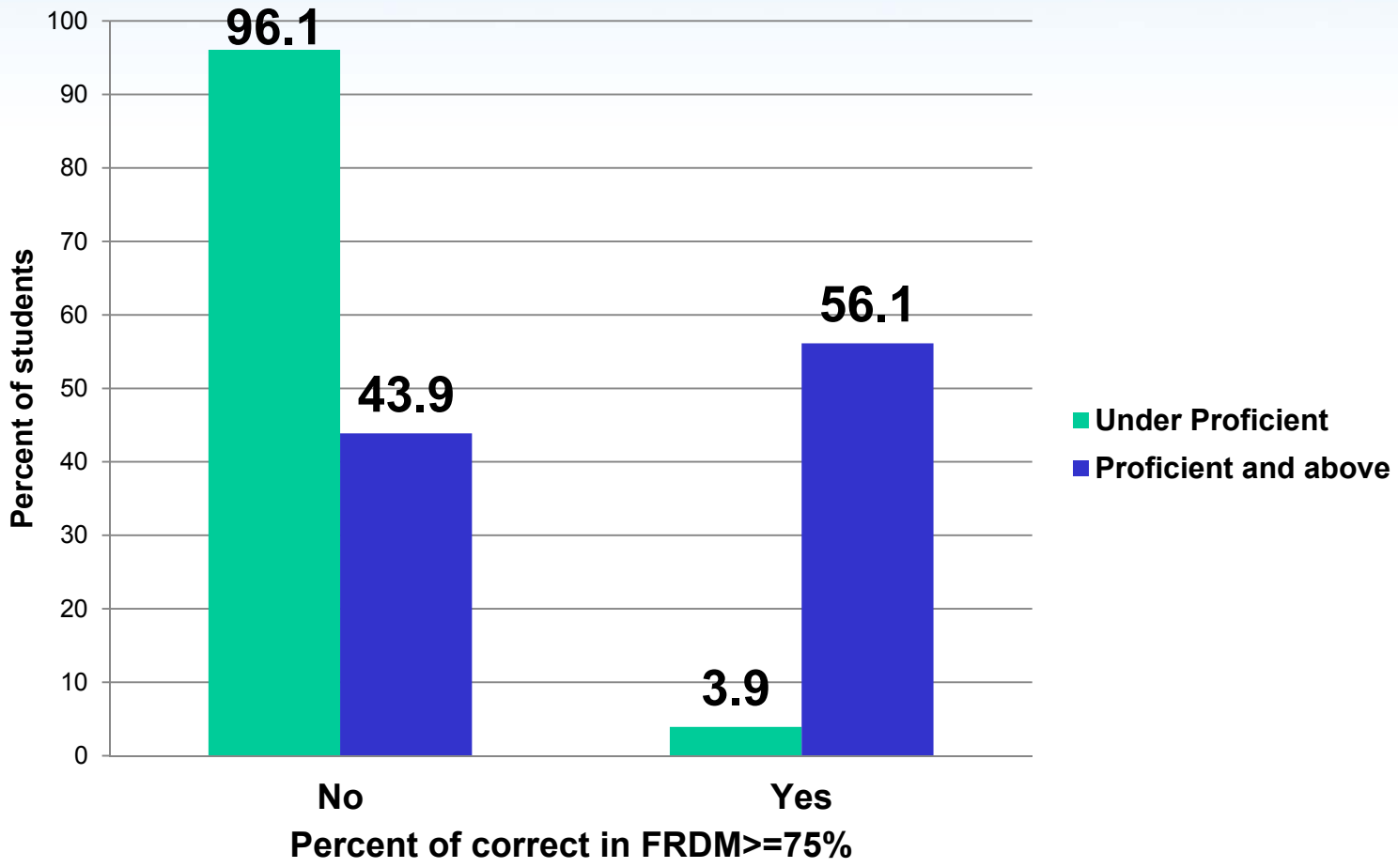
Example: Percent of students who master Fractions and Decimals on the Pre-Algebra readiness test by 2011 CST math at the proficiency level



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Course Sequencing: What is the course objective for the Senior year of high school?

Course sequencing will certainly change under CCSS-M; when acceleration does occur, through compacted courses, content should be the same as full-length courses.

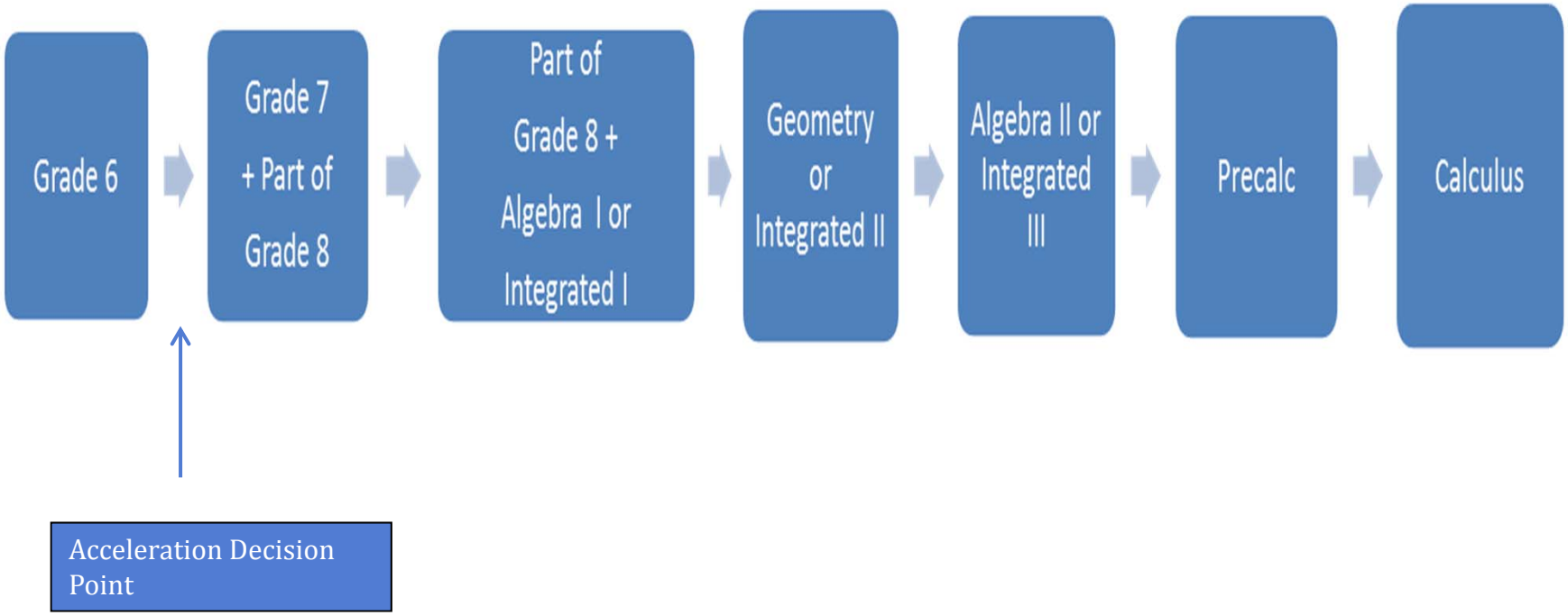
Clear learning progressions through the major mathematical domains need to be retained, consistent with the design of the standards. Omitting concepts should be avoided.

Examples of compacted sequences are increasingly available, and experimentation coupled with evaluation will be required moving forward.

A middle school sequence could, for example, compact grade 7, grade 8 and Algebra 1/Integrated I.

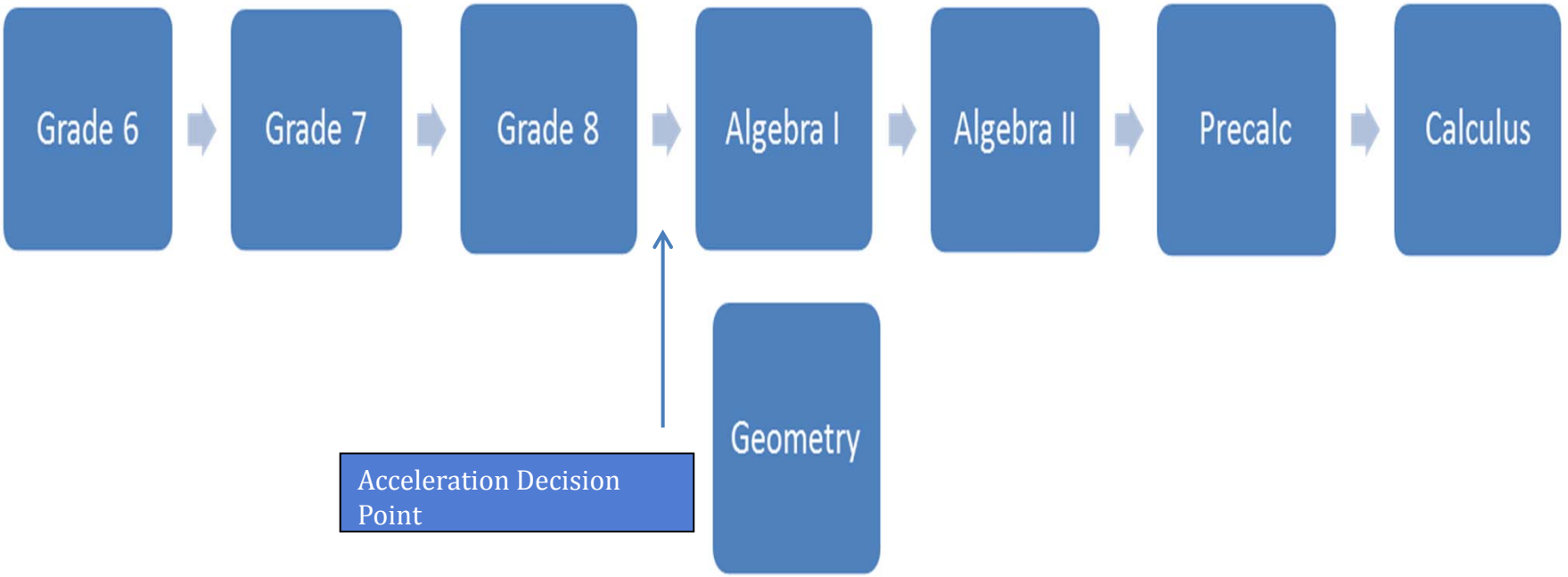
Five ways to Calculus

1) Compacting in Middle School



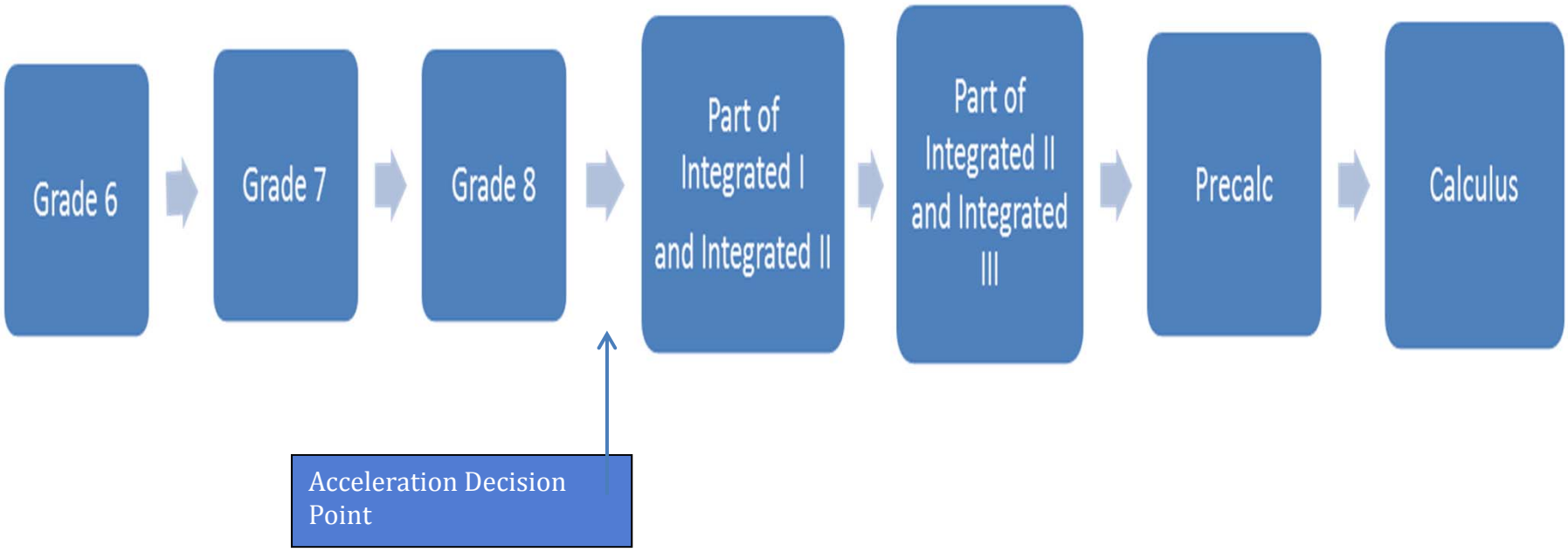
Five ways to Calculus

2) Doubling Up in High School



Five ways to Calculus

3) Accelerated Integrated Pathway



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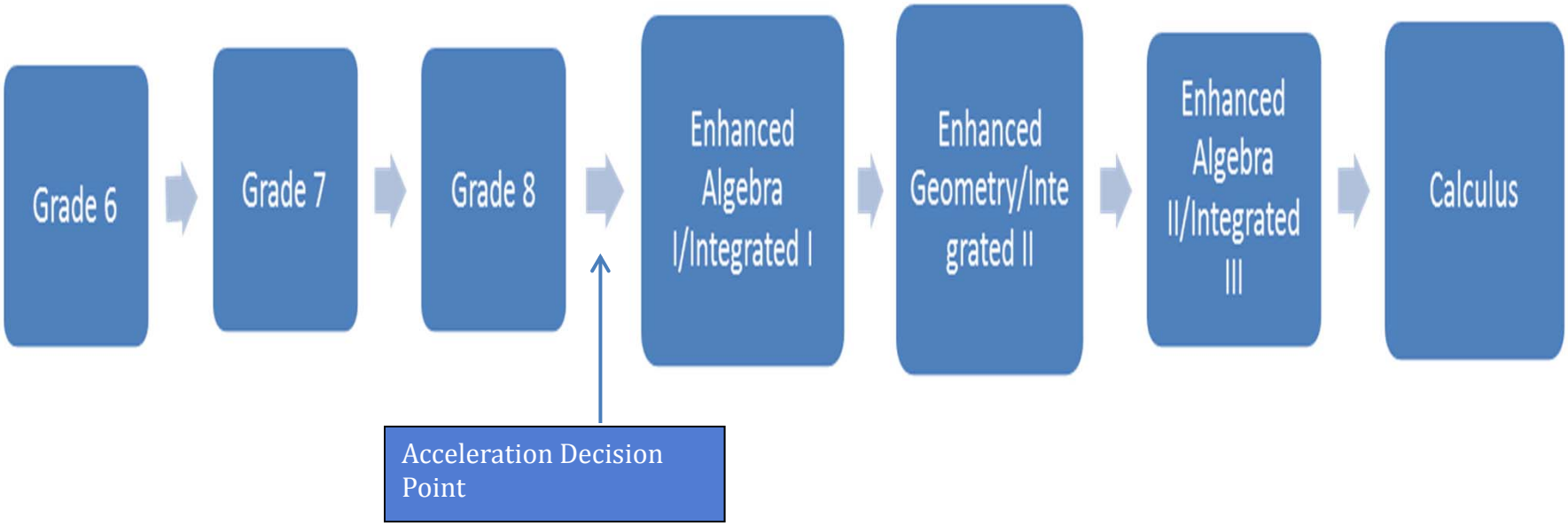
Five ways to Calculus

4) Enhanced Pathway



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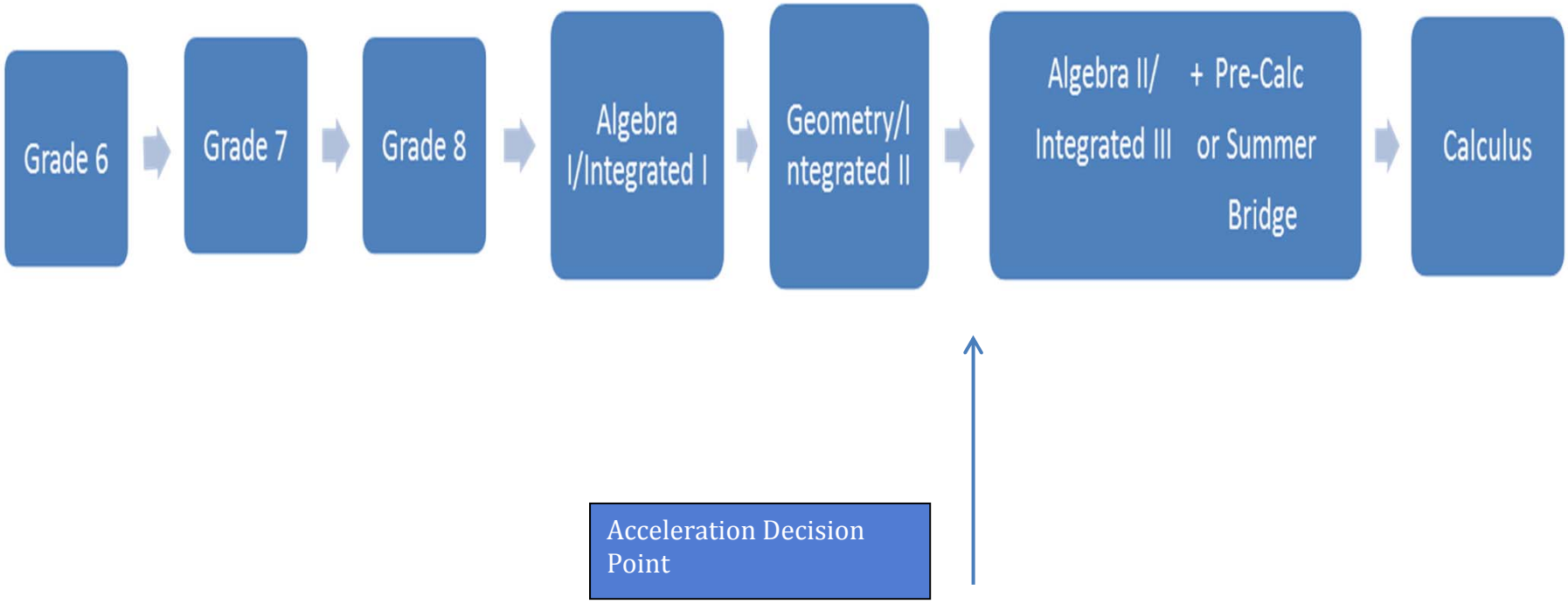
Five ways to Calculus

5) Summer Bridge Pathway



Irrespective of students' math performance, taking four years of high-school math strengthens their postsecondary and employment opportunities in STEM-related fields.

Successful transitions beyond high school, without the need for remediation, are in part dependent on students' consistent math enrollment throughout high school.

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