

Title: Research on Algebra I as an 8th grade math offering

Date: September 2013

Question: >> Do you have any information on how many elementary schools are offering Algebra I (high school level course) as an 8th grade math offering? What type of research supports this movement?

Response:

To answer the request, REL West staff searched selected databases for relevant resources (see “Methods” section on the last page). We organized the information we found into the following categories:

- **Reports and articles:** Research reports and policy-oriented articles about offering Algebra in 8th grade. Resources were judged as relevant by abstracts.
 - Citations include a link to a free online version when available. One publication is available for purchase, as noted.
 - Citations are accompanied by an abstract, excerpt, or summary written by the author or publisher of the article.
- **Relevant organizations** that focus on this topic.

REL West has not done an evaluation of these publications and organizations themselves, and provides them for your information only.

1. REPORTS & ARTICLES

Burris, C. C., Heubert, J. P., & Levin, H. M. (2006). Accelerating mathematics achievement using heterogeneous grouping. *American Educational Research Journal*, 43(1), 105–136. Retrieved on September 10, 2013, from <https://mmsdamps.files.wordpress.com/2008/07/accelerating-mathematics-achievement-using-heterogeneous-grouping.pdf>

Abstract: This longitudinal study examined the effects of providing an accelerated mathematics curriculum in heterogeneously grouped middle school classes in a diverse suburban school district. A quasi-experimental cohort design was used to evaluate subsequent completion of advanced high school math courses as well as academic achievement. Results showed that probability of completion of advanced math courses increased significantly and markedly in all groups, including minority students, students of low socioeconomic status, and students at all initial achievement levels. Also, the

performance of initial high achievers did not differ statistically in heterogeneous classes relative to previous homogeneous grouping, and rates of participation in advanced placement calculus and test scores improved.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2012). *The aftermath of accelerating algebra: Evidence from a district policy initiative* (National Bureau of Economic Research Working Paper #18161). Retrieved on September 10, 2013, from http://www.newyorkfed.org/research/education_seminar_series/algebrapaper-011212.pdf

Abstract: In 2002/03, the Charlotte-Mecklenburg Schools in North Carolina initiated a broad program of accelerating entry into algebra coursework. The proportion of moderately performing students taking algebra in 8th grade increased from half to 85%, then reverted to baseline levels, in the span of just five years. We use this policy-induced variation to infer the impact of accelerated entry into algebra on student performance in math courses as students progress through high school. Students affected by the acceleration initiative scored significantly lower on end-of-course tests in Algebra I, and were either significantly less likely or no more likely to pass standard follow-up courses, Geometry and Algebra II, on a college-preparatory timetable. Although we also find that the district assigned teachers with weaker qualifications to Algebra I classes in the first year of the acceleration, this reduction in teacher quality accounts for only a small portion of the overall effect.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2013). *Algebra for 8th graders: Evidence on its effects from 10 North Carolina districts* (National Center for Analysis of Longitudinal Data in Education Research Working Paper). Retrieved on September 10, 2013, from <http://www.caldercenter.org/publications/upload/wp87-2.pdf>

Abstract: This paper examines the effects of policies that increase the number of students who take the first course in algebra in 8th grade, rather than waiting until 9th grade. Extending previous research that focused on the Charlotte-Mecklenburg school system, we use data for the 10 largest districts in North Carolina. We identify the effects of accelerating the timetable for taking algebra by using data on multiple cohorts grouped by decile of prior achievement and exploiting the fact that policy-induced shifts in the timing of algebra occur at different times in different districts to different deciles of students. The expanded data make it possible to examine heterogeneity across students in the effect of taking algebra early. We find negative effects among students in the bottom 60 percent of the prior achievement distribution. In addition, we find other sources of heterogeneity in effects.

Domina, T., Penner, A., Penner, E., & Conley, A. (2012). *Does detracking work? Evidence from a mathematics curricular reform* (Working Paper). Irvine, CA: University of California, Irvine. Retrieved on September 10, 2013, from http://www.gse.uci.edu/docs/domina_8thgradealgebra.pdf

Abstract: Across the United States, secondary school curricula are intensifying as a growing proportion of students enroll in high-level academic math courses. Using data from a diverse California school district, we examine the role of a multi-year effort to make high-level

middle school mathematics courses more inclusive by placing nearly every 8th grader in Algebra I. We find that curricular intensification increased students' odds of taking higher level mathematics courses and created more skill-heterogeneous 8th grade math classrooms. However, we find the rate of 6th–10th grade mathematics score growth slowed as the district intensified math curricula, particularly students in the middle of the skills distribution. Peer effects are partly to blame for the disappointing effects of curricular intensification on student achievement.

Finkelstein, N., Fong, A., Tiffany-Morales, J., Shields, P., & Huang, M. (2012). *College bound in middle school and high school? How math course sequences matter*. Sacramento, CA: The Center for the Future of Teaching and Learning at WestEd. Retrieved on September 12, 2013, from http://www.cftl.org/documents/2012/CFTL_MathPatterns_Main_Report.pdf

Abstract: Research shows that success in high-level mathematics in high school predicts postsecondary success and careers in the science, technology, engineering, and math (STEM) fields.

Similarly, students' academic successes in middle school can determine their performance in high school. This study, produced by [The Center for the Future of Teaching and Learning at WestEd](http://www.cftl.org), explores the connection between mathematics achievement in middle school and high school to better understand the degree to which students stay on the path toward postsecondary STEM study and, if students veer off the trajectory, to better understand when and why.

Some key findings:

- Seventh-grade math performance predicts high school math course taking
- Continuing to take more advanced math classes each year does not help students who are already not proficient in math in the seventh grade
- Few students who repeat algebra become proficient on their second attempt
- Districts are aware of poor student performance in math and less aware of course-taking patterns
- Districts know they must improve algebra outcomes

The report concludes with a set of considerations for state and local policymakers and education leaders.

Flamm, S., Mabry, T., Mendoza, F., et al. (2011). *Eighth grade math placement and the push towards algebra I in California* (Working Paper). Retrieved on September 10, 2013, from <http://stempowered.svefoundation.org/sites/default/files/Algebra%20for%20All.pdf>

Abstract: In this study, we first provide background on the formation of California's current Algebra I placement goals and a summary of some of the research to date on this issue. We then present case studies on four regions within the Silicon Valley area that have addressed the issue of Algebra placement, specifically San Jose Unified School District, Fresno Unified School District, Merced County, and the East Side Community. These case studies include

basic data on student outcomes in the presence of the different policies across these areas. Finally, we discuss the potential implications of these different district policies and place them within the context of considerations for future policy formation and research.

Liang, J-H., Heckman, P. E., & Abedi, J. (2012). What do the California Standards Test results reveal about the movement toward eighth-grade Algebra for all? *Educational Evaluation and Policy Analysis*, 34(3), 328–343. Retrieved on September 10, 2013, from <http://www.edsource.org/today/wp-content/uploads/Algebra-CST-UCDavisStudy081212.pdf>

Abstract: In California, an increasing number of 8th graders have taken algebra courses since 2003. This study examines students' California Standards Test (CST) results in grades 7 through 11, aiming to reveal who took the CST for Algebra I in 8th grade and whether the increase has led to a rise in students taking higher-level mathematics CSTs and an improved performance in following years. Results show that the pipeline of 8th-grade algebra and following years' higher-level mathematics CSTs has a significant leak in it. Furthermore, the longitudinal analysis reveals that 9th-grade students have a 69 percent greater chance of succeeding in algebra if they passed the CST for General Mathematics in 8th grade compared to those who failed the CST for Algebra I.

Loveless, T. (2013). *The 2013 Brown Center report on American education: How well are American students learning?* (With sections on the latest international tests, tracking and ability grouping, and advanced math in 8th grade). Washington, DC: The Brookings Institution, The Brown Center on Education Policy. Retrieved on September 10, 2013, from <http://www.brookings.edu/~media/Research/Files/Reports/2013/03/18%20brown%20center%20loveless/2013%20brown%20center%20report%20web.pdf>

Excerpt: This is the twelfth edition of the Brown Center Report. The structure of the report remains the same from year to year. Part I examines the latest data from state, national, or international assessments... Part II explores a perennial theme in education studies—the topics that never seem to go away in terms of research and debate... Part III is on a prominent policy or program. This year's analysis is on the national push for eighth graders to take algebra and other high school math courses. Algebra is now the single most popular math course in eighth grade. The study in Part III uses state variation in enrollment rates to ask the question: what has happened to the NAEP scores of states that boosted their eighth-grade advanced-math enrollments? The study uncovers no relationship between change in state NAEP scores and change in enrollments. States boosting advanced math taking are no more likely to show NAEP gains than other states. A second analysis uncovers some evidence consistent with the idea that advanced math courses are being “watered down,” that the mean achievement levels of advanced courses fall as enrollments go up. Again, change in NAEP score is the outcome of interest. The study shows that states that are more selective in math placements—not aggressively accelerating eighth graders into advanced courses—are more likely to show achievement gains in those courses. There is one intriguing divergence from this finding: eighth-grade geometry classes. Geometry sits at the peak of the hierarchy of eighth-grade math courses, enrolling the nation's best math students (about 5%). Presumably, these are students who took algebra in seventh grade. Increases in eighth-grade

geometry enrollments evidence no association with changes in mean achievement for the course, not what one would expect if unprepared students were being accelerated into the course. This suggests that schools are implementing two different types of acceleration, one based on the age or grade of students, the other based on students' preparation and readiness for advanced work. The analyses in the study are only correlational and cannot confirm or reject causality. Part III concludes with a discussion of hypotheses for future study to improve both strategies.

Perry, M. (2013). *Algebra I in the Common Core era*. San Jose, CA: Silicon Valley Education Foundation. Retrieved on September 10, 2013, from http://www.svefoundation.org/svefoundation/files/AlgebraCommonCore_Perry.pdf

Excerpt: This brief provides a broad outline of the Common Core Standards in mathematics and California's adoption process. It focuses more deeply on the questions of Algebra I in 8th grade and the state's new policies related to that. It also explores the implications of these state decisions for course configuration and placement decisions in local school districts. Finally, it discusses issues that local communities will need to address as they redesign their math programs in the months ahead to fit these new expectations.

Smith, J. (1996). Does an extra year make any difference? The impact of early access to algebra on long-term gains in mathematics attainment. *Educational Evaluation and Policy Analysis*, 18, 141–153. Retrieved on September 10, 2013, from <http://www.jstor.org/discover/10.2307/1164553?uid=3739256&uid=2129&uid=2&uid=70&uid=4&sid=21102625751287> (available for purchase)

Abstract: This study investigates the lasting impact of taking algebra before high school on students' subsequent mathematics attainment in high school. Using a nationally representative sample of high school students, I explore the effects of early access to algebra on students' access to advanced mathematics courses and subsequent high school math achievement. Results demonstrate that early access to algebra has an effect beyond simple increased knowledge measures and, in fact, may "socialize" a student into taking more mathematics, regulating access both to advanced coursework and increased achievement in high school. Implications for broader curriculum policy changes concerning early access to algebra are discussed.

Spielhagen, F. R. (2006). Closing the achievement gap in math: The long-term effects of eighth-grade algebra. *Journal of Advanced Academics*, 18(1), 34–59. Retrieved on September 10, 2013, from <http://files.eric.ed.gov/fulltext/EJ753970.pdf>

Abstract: Recent changes in national and state mathematics standards have increased the level of algebraic thinking taught in younger grades. These changes have prompted more inclusive curriculum designs that open the opportunity to enroll in advanced mathematics courses at younger ages. Of particular interest to this study is the access to eighth-grade algebra, once traditionally reserved for select populations. This study examined long-term academic outcomes for students who did or did not enroll in eighth-grade algebra in one

district that implemented an initiative to increase access. The outcomes of students with similar ability, as measured by pre-assessment in seventh grade, were compared. The groups performed similarly on end-of-course exams in high school math and the mathematics section of the SAT I. However, students who completed algebra in the eighth grade stayed in the mathematics pipeline longer and attended college at greater rates than those who did not. Because of the sequential nature of mathematics course work, students taking algebra at an earlier age have the opportunity to enroll in more advanced courses in the future. Results suggest the need for further exploration of how to provide access and promote enrollment in eighth-grade algebra for students who demonstrate readiness.

Stein, M. K., Kaufman, J. H., Sherman, M., & Hillen, A. F. (2011). Algebra: A challenge at the crossroads of policy and practice. *Review of Educational Research*, 81(4), 453–492. Retrieved on September 10, 2013, from http://www.ecs.org/rs/Studies/DetailStudy.aspx?study_ID=a0r70000000AH1CAAW

Abstract: The authors review what is known about early and universal algebra, including who is getting access to algebra and student outcomes associated with algebra course taking in general and specifically with universal algebra policies. The findings indicate that increasing numbers of students, some of whom are underprepared, are taking algebra earlier. At the same time, other students with requisite skills are not given access to algebra. Although studies using nationally representative data indicate strong positive outcomes for students who take algebra early, studies conducted only in contexts where all students are mandated to take algebra in eighth or ninth grade provide mixed evidence of positive outcomes, with increased achievement when policies include strong supports for struggling students. The authors conclude with a call for studies that examine the relationship among algebra policies, instruction, and student outcomes to understand the mechanisms by which policies can lead to success for all students.

U.S. Department of Education. (1997). *Mathematics equals opportunity* (White Paper prepared for U.S. Secretary of Education Richard W. Riley). Washington, DC: Author. (ERIC Document Reproduction Service No. ED415119). Retrieved on September 10, 2013, from <http://mathpl.us/docs/mathemat.pdf>

Abstract: Mastering mathematics has become more important than ever in the United States. Students with a strong grasp of mathematics have an advantage in academics and in the job market. The eighth grade is a critical point in mathematics education. Achievement at that stage clears the way for students to take rigorous high school mathematics and science courses which are the keys to college entrance and success in the labor force. This report highlights the key findings that: (1) students who take rigorous mathematics and science courses are much more likely to go to college than those who do not; (2) algebra is the gateway to advanced mathematics and science in high school, yet most students do not take it in middle school; (3) taking rigorous mathematics and science courses in high school appears to be especially important for low-income students; (4) despite the importance of low-income students taking rigorous mathematics and science courses, these students are less likely to take them; (5) mathematics achievement depends on the courses a student takes, not the type

of school the student attends; (6) students whose parents are involved in their school work are more likely to take challenging mathematics courses early in their academic careers; and (7) results of the Third Mathematics and Science Study (TIMSS) reveal that the middle school mathematics curriculum may be the weak link in the education system in the United States. The next steps that can be taken by educators, policymakers, community members, and parents are also listed.

Williams, T., Haertel, E., Kirst, M. W., et al. (2011). *Improving middle grades math performance: A closer look at district and school policies and practices, course placements, and student outcomes in California*. Mountain View, CA: EdSource. Retrieved on September 10, 2013, from <http://files.eric.ed.gov/fulltext/ED516658.pdf>

Abstract: This report is a follow-up to the *Gaining Ground in the Middle Grades* study, which specified a comprehensive set of actionable practices that differentiated higher academic achievement among 303 middle grades schools in California. This follow-up analysis inquires further into the *Gaining Ground* data to provide a more in-depth look at middle grades mathematics practices and policies. The centerpiece is an empirical exploration of grade 8 Algebra I placement, based on longitudinal data linking the mathematics CSTs that students in the sample took in grade 7 (in 2008) and grade 8 (in 2009). (The findings and implications of this placement analysis are explored further in a companion Policy and Practice Brief, *Preparation, Placement, Proficiency*.) In addition, this report sheds light on how middle grades schools in California are using state-adopted standards and curriculum programs, as well as standards-based assessments, as a basis for their efforts to improve student achievement. It also identifies practices and policies that appear to differentiate higher school achievement in grade 8 mathematics within this standards-based context.

2. RELEVANT ORGANIZATIONS

EdSource

<http://www.edsource.org/>

EdSource works to engage Californians on key education challenges with the goal of enhancing learning success. It does so in three ways: providing timely, useful information to policymakers; advancing awareness among the larger public on complex education issues; and highlighting effective models and strategies intended to improve student outcomes.

[CA] State Board eliminates incentives to offer Algebra in 8th grade (March 2013)

http://www.edsource.org/today/2013/state-board-eliminates-incentives-to-offer-algebra-in-8th-grade/28525#.UjIE1D_hee9

The State Board of Education voted unanimously Wednesday to remove state incentives encouraging schools to offer Algebra I in 8th grade. The move was both a vote of confidence in the new Common Core standards for 8th grade, which districts are now beginning to implement, and a retreat from a decade-old policy of pushing universal algebra in 8th grade.

Proponents of the state’s current policy are predicting that enrollment in Algebra by 8th grade, which has doubled over the past decade to nearly two-thirds of students, will plummet in coming years.

National Council of Teachers of Mathematics

<http://www.nctm.org/>

From the website: The National Council of Teachers of Mathematics is the public voice of mathematics education, supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, leadership, professional development, and research.

The National Research and Development Center on Cognition and Mathematics Instruction (Math Center)

<http://iesmathcenter.org/home/index.php>

From the website: The Math Center is a joint project of WestEd and its university partners, Carnegie Mellon University, Temple University, University of Illinois at Chicago, University of Wisconsin-Madison, and Worcester Polytechnic Institute. The Center brings together experts in cognition, instruction, assessment, research design and measurement, mathematics education, and teacher professional development around the core goal of redesigning components of a widely used middle school mathematics curriculum, Connected Mathematics Project (CMP). This team of experts is using established, evidence-based principles derived from experimental studies in classrooms and controlled laboratory settings. Our goal is to enhance the conditions of instruction and improve learning outcomes for students in important and challenging mathematics concepts and skills.

Methods

Keywords and Search Strings Used in the Search

“Algebra I” AND (“8th grade” OR “eighth grade”)

Search of Databases

ERIC, EBSCO, Google, and Google Scholar

Additional Organizations/Websites Searched

American Institutes for Research; Arizona Department of Education; California Department of Education; Education Commission of the States

Criteria for Inclusion

When REL West staff review resources, they consider—among other things—four factors:

- **Date of the Publication:** The most current information is included, except in the case of nationally known seminal resources.
- **Source and Funder of the Report/Study/Brief/Article:** Priority is given to IES, nationally funded, and certain other vetted sources known for strict attention to research protocols.
- **Methodology:** Sources include randomized controlled trial studies, surveys, self-assessments, literature reviews, and policy briefs. Priority for inclusion generally is given to randomized controlled trial study findings, but the reader should note at least the following factors when basing decisions on these resources: numbers of participants (Just a few? Thousands?); selection (Did the participants volunteer for the study or were they chosen?); representation (Were findings generalized from a homogeneous or a diverse pool of participants? Was the study sample representative of the population as a whole?).
- **Existing Knowledge Base:** Although we strive to include vetted resources, there are times when the research base is limited or nonexistent. In these cases, we have included the best resources we could find, which may include newspaper articles, interviews with content specialists, organization websites, and other sources.

This memorandum is one in a series of quick-turnaround responses to specific questions posed by educators and policymakers in the Western region (Arizona, California, Nevada, Utah), which is served by the Regional Educational Laboratory West (REL West) at WestEd. This memorandum was prepared by REL West under a contract with the U.S. Department of Education’s Institute of Education Sciences (IES), Contract ED-IES-12-C-0002, administered by WestEd. Its content does not necessarily reflect the views or policies of IES or the U.S. Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

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