

Math Works Resource Bank

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Math-Related Articles & Studies

Adelman, Clifford

U.S. Department of Education

[The Toolbox Revisited: Paths to Degree Completion from High School through College](#), 2006

This follow-up study to an earlier study by Adelman examines the predictors of college success. This study follows a nationally representative cohort of students from high school through college to show major predictors for the completion of a bachelor's degree. Adelman found that academic intensity or rigor was the strongest predictor of college success and completion, followed by class rank/GPA. Adelman contends that college going and degree completion could be improved by 30–70 percent for under-represented minority and low-income students by increasing the number of core academic courses and the rigor of these courses, and by ensuring these students move immediately from high school to college.

ACT

[Rigor at Risk: Reaffirming Quality in the High School Core Curriculum](#), 2007

In this report, ACT analyzes the gap between the rigor of high school and expectations for success in postsecondary education and careers. They find that few states require students to take rigorous core courses associated with success after high school and that academic sequences in most states are not aligned with postsecondary expectations. Their research shows that students who take rigorous math and science courses perform better on the ACT college entrance examination, especially when they attend high schools where their peers are also enrolled in those challenging courses. Policy recommendations offered in the report include raising graduation requirements, improving course content standards, providing effective support to teachers, and continually monitoring students' academic progress.

ACT

[Ready for College or Ready for Work: Same or Different?](#), 2006

In this policy paper, ACT examined three research questions: (1) What level of readiness in reading and mathematics is needed to be ready for entry-level jobs that require less than a bachelor's degree, pay a wage sufficient to support a family, and offer the potential for career advancement? (2) Are the levels of performance needed to be college-ready and workforce-ready comparable? and (3) Are ACT scores that benchmark to college and workforce readiness similar or different? By exploring those questions, and data from the ACT and WorkKeys assessments, the report provides empirical evidence that that comparable readiness is needed whether planning to enter college or workforce training programs after graduation and recommends that policies be set to reflect this convergence.

Bozick, Robert, Steven J. Ingels, and Jeffrey A. Owings

National Center for Education Statistics, U.S. Department of Education

[Mathematics Course Taking and Achievement at the End of High School: Evidence from the Education Longitudinal Study of 2002](#), 2008

This report documents and examines the relationship between the number and types of math courses taken in the 11th and 12th grade and growth in mathematics proficiency over the same time period. Using

data from the Education Longitudinal Study of 2002 (ELS:2002), the analysis identifies the coursetaking sequences most prevalent among contemporary high school students in their junior and senior years. Their findings show that the largest overall gains are made by students who take precalculus and one other math course during the last two years of high school. In terms of learning in specific content areas, the largest gains in intermediate skills such as simple operations and problem solving were made by those who followed the geometry–algebra II sequence. The smallest gains were made by students who took one mathematics course or no mathematics courses during their last two years of high school.

Carnevale, Anthony P. and Donna M. Desrochers
Educational Testing Service

[Standards for What? The Economic Roots of K-16 Reform. Educational Testing Service, 2003](#)

The authors synthesize economic, demographic and educational trend data and discuss the continuing growth in demand for skilled workers and the persistent pressure on the American education system to meet high standards for a growing share of students. It documents the increased demand for high skills in jobs and the decreasing opportunities for individuals with no post-secondary education or training. The report notes that education is related to the nation's competitiveness and economic stability and that the gap in wages based on education attainment will only continue to grow. In particular, the authors contend that the goal of K-12 education should be to prepare students for more education whether that is vocational training, community college, certification or a four-year degree to adequately prepare them for the workforce.

Epstein, J.L., & D.J. Maclver
The Johns Hopkins University

[Opportunities to Learn: Effects on Eight Graders of Curriculum Offerings and Instructional Approaches 1992](#)

The report, using survey data of over 24,000 eighth graders, explores the relationship between middle school curriculum and instruction, such as access to courses, course-taking, rigor level and content, and student success. Overall, they find that middle schools rarely offer challenging advanced academic courses or enriched learning opportunities. They also find that students in homogenous Algebra classes (ability grouping) perform better regardless of their ability level, and that more rigorous academic courses increase student achievement and motivation to learn. Regardless of ability, students who take Algebra I in middle school benefit to a greater extent than students who take lower level math courses. The results suggest that more rigorous academic courses are needed during middle school and students of all ability levels will benefit from such experiences.

Harvard University, Science Daily

[College Science Success Linked to Math and Same-Subject Preparation, 2007](#)

The article finds that students with the most rigorous high school preparation in mathematics perform significantly better in college courses in biology, chemistry and physics. Math skills are a prerequisite of science in college and students with strong high school preparation are more likely to major in and be successful in science. Comparatively, and as previous research has found, students who are successful in one science domain (e.g., Biology, Physics) in high school are no more likely to perform better than other students in college science courses. The results suggest that some of the arguments for the 'Physics First' movement, that it will prepare students for success in other sciences, may be called into question.

Horn, L. and A.M. Nuñez

National Center for Education Statistics, U.S. Department of Education

[Mapping the Road to College: First-Generation Students' Math Track, Planning Strategies, and Context of Support, 2000](#)

This report compares first-generation college students with peers whose parents had attended college, focusing on mathematics course-taking – including the effectiveness of taking algebra in 8th grade and advanced math courses in high school. The report also examines the involvement of students' parents, teachers and others capable of helping them prepare for college. It reports that first-generation students are significantly less likely to take the courses required for college success; however, it also notes that all students who complete math through Algebra II or higher increase their probability for college enrollment

significantly. Students whose parents graduated from college were more likely than first generation students (48 percent vs. 34 percent) to indicate they were involved in the selection of their math coursework during high school.

National Academies of Science

[Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, October 2006](#)

This report was presented to Congress by a 20-member committee composed of university presidents, CEOs, Nobel Prize winners, and former presidential appointees. It analyzes the current economic challenges facing the U.S. and develops four overarching recommendations along with 20 implementation actions that federal policymakers can take to create high-quality jobs and focus new science and technology efforts on meeting the nation's energy needs. The four recommendations are: increase America's talent pool by vastly improving K-12 math and science education; sustain and strengthen the nation's commitment to long-term basic research; develop, recruit, and retain top students, scientists, and engineers from both the United States and abroad; and ensure that the U.S. is the premier place for world innovation.

National Center for Education Statistics, U.S. Department of Education

[High School Coursetaking: Findings from the Condition of Education, 2007](#)

The National Center for Education Statistics publishes an annual report – Condition of Education – to track important trends in U.S. education, such as participation and persistence in education, student performance and other measures of achievement, the environment for learning, and resources for education. In 2007, the report's Special Analysis focused on access to and participation and success in high school course-taking between 1982 and 2005, drawing data from national high school transcript studies.

National Center for Education Statistics, U.S. Department of Education

[Advanced Mathematics and Science Coursetaking in the Spring High School. Senior Classes of 1982, 1992, and 2004, 2007](#)

This report provides a comparison of high school course-taking between students from the top and bottom socio-economic status (SES) quartiles, defined by parents' income and occupational status. The report examines trends in academic course-taking in both mean credits earned in math and science and in the highest course level that high school graduates completed in the two subjects. The study finds that, on average, academic coursework and course-taking increased for all students over this time, although some disparities between socio-economic groups also increased over time, as the percentage of high-SES students taking pre-calculus and calculus grew at a faster rate than those in the lowest-SES group.

The National Commission on Mathematics and Science Teaching for the 21st Century

[Before It's Too Late, September 2000](#)

This report, also known as the Glenn Commission report, was submitted to the Department of Education by a distinguished panel of educators, business leaders and policymakers to offer recommendations for education reform to keep America competitive in the global economy. The report offers three overarching goals: improve the quality of K-12 math and science instruction, increase the number of qualified and prepared math and science teachers, and make the teaching profession more attractive for K-12 math and science teachers.

National Mathematics Advisory Panel, U.S. Department of Education

[Foundations for Success: The Final Report of the National Mathematics Advisory Panel, 2008](#)

The National Mathematics Advisory Panel was convened to review scientific research and offer recommendations for how the U.S. can improve mathematics instruction and prepare all students for Algebra. The panel put forward six principles, based on the message to *put first things first*: (1) curriculum in Grades PreK–8 should be streamlined and emphasize a well-defined set of the most critical topics in the early grades; (2) use should be made of what is clearly known from rigorous research about how children learn; (3) more rigorous initiatives are required to attract, prepare, evaluate and retain effective teachers; (4) instructional practice should be informed by research and by the best professional judgment and experience of accomplished classroom teachers; (5) the National Assessment of Educational

Progress (NAEP) and state assessments should carry increased emphasis on the most critical knowledge and skills leading to Algebra and (6) the nation must continue to build capacity for more rigorous research in education so that it can inform policy and practice more effectively.

National Research Council

[Everybody Counts: A Report to the Nation on the Future of Mathematics Education, 1998](#)

This book addresses students' lack of mathematical literacy and preparation for tomorrow's jobs. The book then discusses why students in this country do not perform well in mathematics and outlines a comprehensive, national plan for revitalizing mathematics education in America. It argues for a national support structure that encourages and supports local K-12 and postsecondary mathematics instruction reforms.

Organization for Economic Cooperation and Development

[PISA 2006: Science Competencies for Tomorrow's World—Briefing Note for the United States. December, 2007](#)

This side by side table shows that differentiation between global trends and U.S. results regarding the PISA, an international test assessing the math, science and reading literacy of 15 year olds. This brief gives a statistical analysis of the results from the 2006 administration, including how countries stack up against one another – and in particular against the U.S. – on the test. This study frequently is cited as evidence that the U.S. has generally stagnated in college enrollment and success, while other nations have caught up, and that U.S. achievement now lags behind many other nations.

Packer, Arnold

National Forum on Quantitative Literacy

[What Mathematics Should 'Everyone' Know and Be Able to Do?](#)

This essay discusses a teaching technique called "quantitative literacy," which refers to teaching course content through inductive teaching, or allowing students to first learn mathematics through specific, relevant examples that reflect real applications of mathematical concepts required in the workplace, marketplace and society. The author encourages teachers and professors to rely on project-based lessons, rooted in real-world applications from the perspective of a worker, consumer, citizen and personal interest, while recognizing this will require a shift in pedagogy and assessments.

Rose, Heather and Julian R. Betts

Public Policy Institute of California (PPIC)

[Math Matters: The Links Between High School Curriculum, College Graduation and Earnings, 2001](#)

This study examines the relationship between mathematics in high school and earnings 10 years later. The authors study a variety of characteristics including students' demographic characteristics, measures of student motivation and ability, family background, and high school characteristics. The report – based on a transcript study of tenth-graders in 1980 and ten-year follow-up to obtain educational credentials and earnings – finds that the relationship between curriculum and earnings remains quite strong. However, it also contends that the rigor of courses is more important than the number of courses. PPIC also released a research brief summarizing the study: [Higher Math in High School Means Earnings Later.](#)

Schoenfeld, Alan H.

Education Researcher

[Making Mathematics Work for All Children: Issues of Standards, Testing, and Equity, 2002](#)

This article begins by explaining how individuals who are not quantitatively literate will only be qualified for, and therefore will only get, jobs in the lowest positions, arguing that mathematics education is a civil rights issue. The author provides a good overview of the major national math reforms of the 1990s and addresses four conditions necessary for providing high quality mathematics instruction for all children: (1) high quality curriculum; a (2) stable, knowledgeable and professional teaching community; (3) high quality assessment that is aligned with curricular goals; and (4) stability and mechanisms for the evolution of curricula, assessment, and professional development.

Steen, Lynn Arthur

Mathematical Association of America

[Quantitative Literacy: Why Numeracy Matters for Schools and Colleges.](#)

This article summarized a forum on quantitative literacy held at the National Research Council. Supported by the Pew Charitable Trusts, the forum was sponsored by the National Council on Education and the Disciplines and hosted by the Mathematical Sciences Education Board in cooperation with the MAA. Many contemplated different definitions of qualitative literacy, as well as the potential impact on social structures and lifelong opportunities associated with rigorous math course-taking and mathematical literacy.

Strong American Schools

[A Stagnant Nation: Why American Students Are Still at Risk, April 2008](#)

This report addresses the recommendations presented by A Nation at Risk, a report issued in 1983 that helped to jumpstart the standards-based reform movement. A Nation at Risk called for swift action and reforms to the U.S. education system to prevent a loss of our competitive advantage. Many of the recommendations in Nation at Risk have not been adopted or implemented and, according to Strong American Schools, this is primary due to the lack of vigorous national leadership to improve education. Without national leadership, states and local school systems simply cannot overcome the obstacles to making the major changes necessary to significantly improve our nation's K-12 schools.

Tapping America's Potential

[Tapping America's Potential: The Education for Innovation Initiative, July 2005](#)

Tapping America's Potential is a campaign championed by fifteen national business organizations to double the number of students receiving bachelor's degrees in science, technology, engineering, and math (STEM) by 2015. This report highlights the need for more students pursuing STEM degrees in the global economy and offers a number of actionable recommendations to establish a new education infrastructure and improve the skills of the U.S. workforce.

Venezia, Andrea, Michael W. Kirst, and Anthony L. Antonio

Stanford University's Bridge Project

[Betraying the Dream: How Disconnected K-12 and Postsecondary Education Systems Undermine Student Aspirations, 2003](#)

This report describes in detail the specific problems leading to the disconnect between K-12 and higher education, including a lack of alignment between high school and postsecondary course expectations, assessments and requirements for graduation and admissions. The report goes on to explain why there is this disconnect and provides recommendations on how to improve this national education problem.

WestEd

[Rethinking High School: Supporting All Students to be College-Ready in Math, April 2008](#)

This report, part of a series of reports on high school reform for the Bill and Melinda Gates Foundation, examines how three struggling high schools successfully improved student mathematics achievement by implementing research-based strategies. Among the strategies the schools highlighted in the report focused on were: offering rigorous high-level math courses and supports to all students; helping teachers develop and continually improve skills that enable them to teach math effectively to students with varying levels of proficiency; and consistently assessing student learning – formally and informally – to drive instruction.

Achieve's Math Resources

Math Works

<http://www.achieve.org/MathWorks>

The *Math Works* advocacy kit provides resources that make the case for why all students - regardless of their plans after graduation - should engage in rigorous math course-taking throughout their high school experiences. The *Math Works* materials - ranging from fact sheets, PowerPoint presentations, brochures and others - are resources for policymakers, advocates, educators, parents and students alike that

highlight the connection between higher-level mathematics course-taking and college access and success, workplace and career readiness, and personal and U.S. competitiveness.

Mathematics at Work

www.achieve.org/MathatWork

The brochures present case studies drawn from leading industries nationwide to illustrate the advanced mathematics knowledge and skills embedded in jobs that offer opportunities for advancement and are accessible to high school graduates.

Business Leader's Tool Kit

www.biztools4schools.org/

The "Business Tools for Better Schools" toolkit creates a "one-stop" shopping site where business can get background information, facts, research and practical tools for engaging in education reform. The toolkit was developed in consultation with national, state and local business organizations as well as companies with support from the GE Foundation. The toolkit is designed to be business-oriented and user friendly, both for those with experience in education reform and newcomers. The toolkit is organized into four major sections: *Case for Action*, *Education Priorities*, *Business Champions and Tools for Action*. Among the *Education Priorities* are: ensuring all high school graduates are college- and career-ready, improving the STEM pipeline and focusing on data-driven decision making.

Algebra II End-of-Course Exam

<http://www.achieve.org/node/842>

Fifteen states, working with Achieve, have developed a Common Algebra II end-of-course assessment, the largest multi-state assessment partnership to date. The exam is intended to improve high school Algebra II curriculum and instruction, including consistency of content and rigor within and across the states; serve as an indicator of readiness for first-year college credit-bearing courses; and to provide a common measure of student performance within and across the states over time. In spring 2008, 12 states administered the assessment for the first time to over 90,000 students. A progress report on this administration can be found here: <http://www.achieve.org/2008Algebra2report>.

Mathematics Benchmarks, Grades K-12

<http://www.achieve.org/node/966>

The American Diploma Project (ADP) Math Benchmarks describe the skills and knowledge necessary for the high school graduate to succeed in both the college classroom and the workplace. The benchmarks are cumulative, describing what students need to learn by the end of high school. Achieve has "backmapped" the ADP Mathematics benchmarks from Grade 12 down through Kindergarten to provide states with more detail about the progression of content and skills students need to master in order to meet the end-of-high-school ADP benchmarks.

Mathematics Benchmarks, Grades K-12 Resources

<http://www.utdanacenter.org/k12mathbenchmarks/index.php>

Achieve and the Charles A. Dana Center at The University of Texas at Austin jointly launched web-based tools to help states, districts and schools establish mathematics coursework aligned with entry requirements for higher education and the workplace. The online resource provides benchmarks and tools to ensure that mathematics education is streamlined and connected from grade to grade as students progress toward high school graduation. Also included are classroom and workplace tasks that illustrate the practical application of the benchmarks, model course sequences for integrated and traditional middle and high school courses, and fourth year capstone courses and evaluation tools.

Rising to the Challenge: Are High School Graduates Prepared for College and Work?

<http://www.achieve.org/RisingtotheChallenge>

In this survey, high school graduates entering either college or the workforce, college professors and employers report that high school graduates are not prepared for college or work, did not feel challenged in high school, and would have worked harder if more was expected of them. Achieve worked with Peter D. Hart Research Associates to poll 861 high school graduates currently enrolled in college, 626

graduates not enrolled in college, 300 college professors and 400 employers. A [PowerPoint summary](#) also is available.

The Expectations Gap, 2008: An Annual 50-State Progress Report on the Alignment of High School Policies with the Demands of College and Careers, 2008

<http://www.achieve.org/ClosingtheExpectationsGap2008>

This report serves as Achieve's third annual 50-state progress report. As of February 2008, Achieve reports that while more than a third of states have raised high school standards and graduation requirements, there is more work to be done to ensure that all students graduate ready for college and careers. The report details state progress implementing the American Diploma Project policy agenda that advocates for the alignment of standards, graduation requirements, assessments, data systems and accountability with the expectations of college faculty and employers.

Math-Related Resources/Organizations

National Council of Teachers of Mathematics

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

The National Council of Teachers of Mathematics is a public voice of mathematics education, providing vision, leadership and professional development to support teachers in ensuring equitable mathematics learning of the highest quality for all students. Two of NCTM's most powerful resources are [Principles and Standards for School Mathematics](#), which outlines the essential components of a high-quality school mathematics program and presents a common foundation of mathematics to be learned by all students, and [Curriculum Focal Points](#), which identifies the three important topics at each grade level pre-K–8, and is the next step in implementing the Standards.

Dana Center

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

The Dana Center provides Texas education leaders with new knowledge about teaching and learning and also supports K–12 teachers and leaders throughout the country working to implement high academic standards for all students. The Dana Center conducts research, offers continuing education to teachers and administrators, and creates resources to help the professionals responsible for the education of our children. The Center's purpose is to help more children successfully master a rigorous curriculum.

The Mathematical Association of America

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

The Mathematical Association of America (MAA) is the largest mathematical society in the world that focuses on mathematics for students, faculty, professional mathematicians, and all who are interested in the mathematical sciences; that is, mathematics at the undergraduate level. Its members include university, college, and high school teachers; high school, undergraduate and graduate students; and others in academia, government, business, and industry. The MAA's core interests are Education, Research, Professional Development, Public Policy, and Public Appreciation. The MAA's student web pages - http://www.maa.org/students/middle_high/ - cover topics in academics, careers, research/summer opportunities, meetings for students, and more.