



Seven Keys to College Readiness Update

Montgomery County Public Schools

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Focus on Key 4:

Algebra 1 in Middle School is Key to College Readiness

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Grade 8 has long been recognized as a pivotal point in mathematics education and postsecondary planning (U.S. Department of Education, 1995, 1997; Spielhagen, 2006). Nationally, more than 80 percent of Grade 8 students of all races and ethnicities report that they expect to earn a bachelor's degree or higher (Wimberly & Noeth, 2005). Yet only about 20 percent of Grade 8 students have acquired the knowledge and skills they need to be successful in rigorous high school courses that prepare them for college and the workplace (ACT, 2003, 2004, 2008).

Middle school students who successfully complete Algebra 1 are less likely to need remediation upon entry to college and more likely to enroll in college, remain in college, and earn a bachelor's degree (Adelman, 1999, 2006; Atanda, 1999; Finkelstein & Fong, 2008; Raudenbush, Fotiu, & Cheong, 1998; Smith, 1996; U.S. Department of Education, 2008; Von Secker, 2005). Montgomery County Public Schools (MCPS) has identified completion of Algebra 1 with a C or higher by the end of Grade 8 as one of the keys to college readiness (Von Secker, 2009).

The purpose of this accountability update is to present some of the research and data that highlight the value of completing Algebra 1 with a C or higher by the end of Grade 8. Postsecondary outcomes are reported for 33,788 students in the MCPS Classes of 2001 to 2004. Data for MCPS graduates were drawn from MCPS records and the National Student Clearinghouse, a research service that provides college enrollment and degree information (National Student Clearinghouse, 2009).

College Remediation

About 75 percent of colleges offer remedial mathematics courses for students who are unprepared for college-level mathematics. Incoming freshmen at those colleges are not allowed to enroll in credit-bearing mathematics courses unless they demonstrate that they have the knowledge and skills to succeed without remediation or until they

complete prerequisite remedial courses (Achieve, Inc., 2006; Business-Higher Education Forum, 2005). Nationally, about one third of high school graduates who enroll in college are required to take one or more remedial mathematics courses (Strong American Schools, 2008). Among two of the fastest-growing college populations, African American and Hispanic students, mathematics remediation rates are about 40 percent (Pearson, 2009).

Students who complete Algebra 1 by the end of Grade 8 are more likely to be prepared for college mathematics (ACT, 2008). Among MCPS students in the Classes of 2001 to 2004 who completed Algebra 1 with a C or higher by the end of Grade 8, 88 percent were identified as prepared for college mathematics and unlikely to need remediation upon entry to college. Of students who did not complete Algebra 1 with a C or higher by the end of Grade 8, only 26 percent were identified as prepared for college mathematics and unlikely to be required to take remedial mathematics courses upon entry to college.

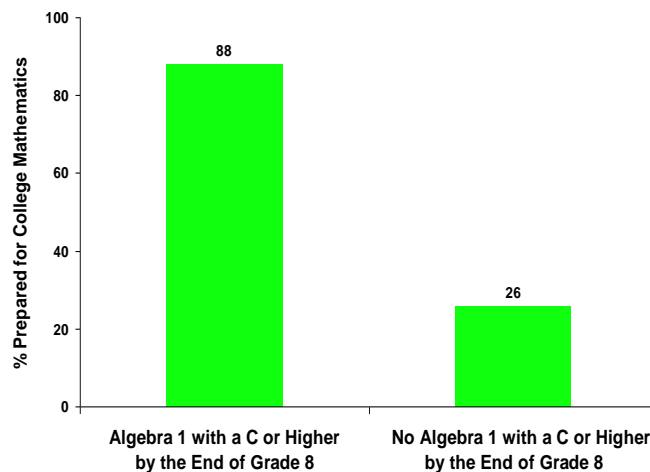


Figure 1. Percentage of graduates in the MCPS Classes of 2001 to 2004 who were prepared for college mathematics (had SAT math score of 550 or higher) by Algebra 1 status at the end of Grade 8.

College Enrollment, Persistence, and Degree Attainment

Algebra 1 is a gateway to postsecondary success and one of the most powerful predictors of bachelor's degree attainment (ACT, 2004, 2008). Students who take a challenging curriculum, beginning in the middle school, tend to perform better academically in high school and are better prepared for college than those who take less rigorous

courses (Finkelstein & Fong, 2008; Gamoran & Hannigan, 2000; Smith, 1996; Spielhagen, 2006; Von Secker, 2005). The correlation exists in part because Algebra 1 is a prerequisite for many college courses, not only in mathematics and science, but also in social science, economics, business, and technology. In MCPS, college degree attainment rates among students who completed Algebra 1 with a C or higher by the end of Grade 8 are more than two times those of students with lesser preparation (Figure 2).

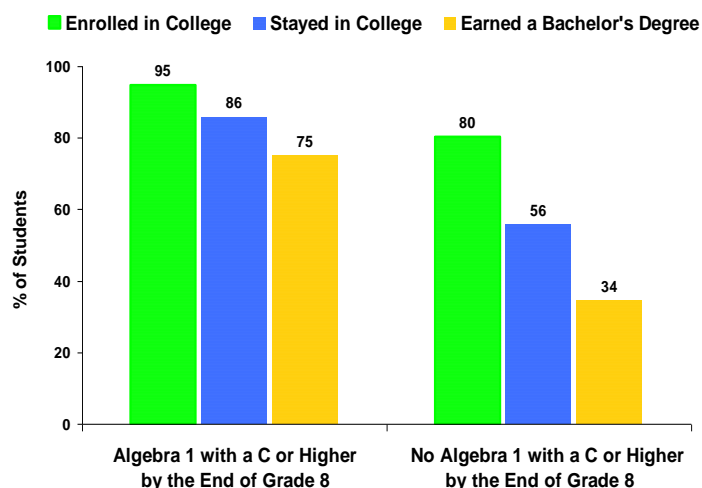


Figure 2. College enrollment, persistence (stayed in college), and degree attainment for graduates in the MCPS Classes of 2001 to 2004 by Algebra 1 status at the end of Grade 8.

Among students in the Classes of 2001 to 2004, 95 percent who completed Algebra 1 with a C or higher by the end of Grade 8 enrolled in college. Of those students, 86 percent stayed in college (persisted) and earned credits toward a degree, and 75 percent earned a bachelor's degree. Likewise, 80 percent of students in the study who had not completed Algebra 1 with a C or higher by the end of Grade 8 enrolled in college, a rate higher than the national average of about 69 percent (Bureau of Labor Statistics, 2009). However, of those students, only 56 percent stayed in college and earned credits toward a degree, and only 34 percent earned a bachelor's degree.

Narrowing Racial and Ethnic Differences in College Achievement

Algebra 1 completion, while a desired outcome for all middle school students, is particularly important for improving college readiness among minority students (Camblin, 2003; Evan, Gray, & Olchefske, 2006; Greene & Forster, 2003; Moses & Cobb, 2001; Pearson, 2009).

On average, students who are African American and Hispanic earn fewer high school mathematics credits than their Asian American and White peers and are less likely to successfully complete Algebra 1 (Horn & Nuñez, 2000; Schoenfeld, 2002). This leaves African American and Hispanic students less prepared for college-level course work.

The relationship of Algebra 1 completion with a C or higher by the end of Grade 8 and college degree attainment was particularly striking for African American and Hispanic students in the MCPS Classes of 2001 to 2004 (Figure 3). African American students who completed Algebra 1 with a C or higher by the end of Grade 8 earned college degrees at rates that were three times the rate of other African American students. Hispanic students who completed Algebra 1 with a C or higher by the end of Grade 8 earned college degrees at rates that were nearly four times the rate of other Hispanic students.

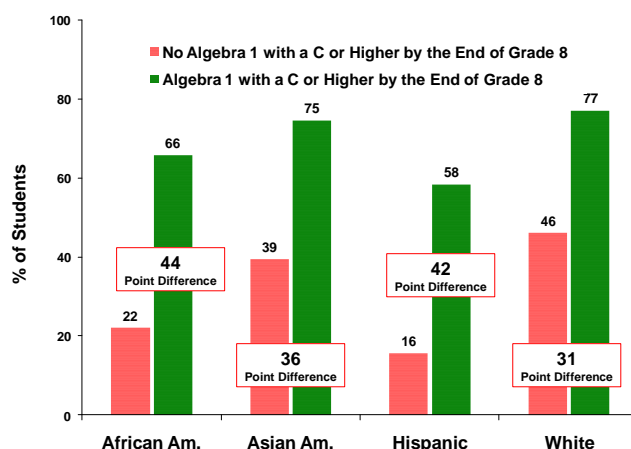


Figure 3. Percentage of graduates in the MCPS Classes of 2001 to 2004 who have earned a bachelor's degree by race/ethnicity and Algebra 1 status.

Seventy-five percent of students in the MCPS Classes of 2001 to 2004 who completed Algebra 1 with a C or higher by the end of Grade 8 earned a bachelor's degree within six years. Among students of the same race and ethnicity, students who had completed Algebra 1 with a C or higher by the end of Grade 8 earned bachelor's degrees at rates that were more than 30 percentage points higher than the percentages of students with less mathematics preparation.



Discussion

National emphasis on Algebra 1 completion by the end of Grade 8 has led to more equitable opportunities for students of all races and ethnicities. In the 1990s, access to Algebra 1 in Grade 8 was reserved for about one in six students, few of whom were students of color. Over the last two decades, Grade 8 Algebra 1 enrollment rates nearly doubled to about one in three students. By 2007, Algebra 1 was the most commonly taken Grade 8 mathematics course in the United States and universal access to Algebra 1 by the end of Grade 8 was viewed as a “civil right” for all students (Loveless, 2008; Moses & Cobb, 2001).

The transition from Grade 8 to high school lays the foundation for students’ successful transitions from high school to college and the workplace. Grade 8 students who have completed Algebra 1 are more likely to have the essential knowledge and skills they need to be successful in the high school courses that prepare them for postsecondary success. MCPS students in the Classes of 2001 to 2004 who completed Algebra 1 with a C or higher by the end of Grade 8 were less likely to need remediation upon entry to college and more likely to enroll in college, remain in college, and earn a bachelor’s degree (Tables A1 to A4).

While enrollment in Algebra 1 by the end of Grade 8 is important, enrollment by itself does not guarantee postsecondary success. Students who successfully complete Algebra 1 with a C or higher prior to high school are able to subsequently complete a high school mathematics sequence that includes Algebra 2 and higher level mathematics courses. Middle school mathematics readiness opens doors to rigorous curricular options in high school, which in turn prepare students for success in college courses.


Middle school students who complete Algebra 1 with a C or higher by the end of Grade 8 are more likely to—

- be prepared for college mathematics courses;
- enroll in college;
- stay in college (persist); and
- earn a bachelor’s degree.



References

- Achieve, Inc. (2006). *Closing the expectations gap: An annual 50-state progress report on the alignment of high school policies with the demands of college and work*. Washington, DC: Author.
- ACT. (2003). *Eighth grade students underestimate college preparation needs*. Iowa City, IA: Author.
- ACT. (2004). *Crisis at the core: Preparing all students for college and work*. Iowa City, IA: Author.
- ACT. (2008). *The forgotten middle: Ensuring that all students are on target for college and career readiness before high school*. Iowa City, IA: Author.
- Adelman, C. (1999). *Answers in the toolbox: Academic intensity, attendance patterns and bachelor's degree attainment*. Washington, DC: U.S. Department of Education.
- Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U.S. Department of Education.
- Atanda, R. (1999). *Do gatekeeper courses expand education options?* Washington, DC: National Center for Education Statistics.
- Bureau of Labor Statistics. (2009). *College enrollment and work activity of 2008 high school graduates*. Washington, DC: U.S. Department of Labor.
- Business-Higher Education Forum. (2005). *Handbook for a commitment to America's future: A Toolkit for leaders of state-level P-16 councils*. <http://www.bhef.com/publications>.
- Camblin, S. (2003). *The middle grades: Putting all students on track for college*. Boston: Pathways to College Network.
- Evan, A., Gray, T., & Olchefske, J. (2006). *The gateway to student success in mathematics and science*. Washington, DC: American Institutes for Research.
- Finkelstein, N. D., & Fong, A. B. (2008). *Course-taking patterns and preparation for postsecondary education in California's public university systems among minority youth*. Washington DC: U.S. Department of Education.
- Gamoran, A. & Hannigan, E. C. (2000). Algebra for everyone? Benefits of college-preparatory mathematics for students of diverse abilities in early secondary school. *Educational Evaluation and Policy Analysis*, 22(3), 241-254.

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- Greene, J. P., & Forster, G. (2003). *Public high school graduation and college readiness rates in the United States*. New York: Manhattan Institute of Policy Research.
- Horn, L., & Nuñez, A. (2000). *Mapping the road to college: First-generation students' math track, planning strategies, and context of support*. Washington, DC: U.S. Department of Education.
- Loveless, T. (2008). *The misplaced math student: Lost in eighth-grade Algebra*. Washington, DC: Brown Center on Education Policy.
- Moses, R. P., & Cobb, C. E. (2001). *Radical equations: Math, literacy, and civil rights*. Boston: Beacon Press.
- National Student Clearinghouse. (2009). *About the clearinghouse*. <http://www.studentclearinghouse.org/about/default.htm>.
- Pearson. (2009). *College readiness*. Retrieved from <http://www.pearsoned.com>.
- Raudenbush, S.W., Fotiu, R.P., & Cheong, Y.F. (1998). Inequality of access to educational resources: A national report card for eighth-grade math. *Educational Evaluation and Policy Analysis*, 20(4), 253-267.
- Schoenfeld, A. H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Education Researcher*, 31(1), 13–25.
- Smith, J. (1996). Does an extra year make any difference? The impact of early access to algebra on long-term gains in mathematics achievement. *Educational Evaluation and Policy Analysis*, 18(2), 141-153.
- Spielhagen, F. R. (2006). Closing the achievement gap in math: The long-term effects of eighth-grade algebra. *Journal of Advanced Academics*, 18, 34–59.
- Strong American Schools. (2008). *Diploma to nowhere*. Washington, DC: Author.
- U.S. Department of Education. (1995). *Mathematics course taking and gains in mathematics achievement*. Washington, DC: Author.
- U.S. Department of Education. (1997). *Mathematics equals opportunity*. Washington, DC: Author.
- U.S. Department of Education. (2008). *Foundations for success: The final report of the national mathematics advisory panel*. Washington, DC: Author.



- Von Secker, C. (2005). *The impact of taking Algebra 1 versus Math C in Grade 8 on high school mathematics course taking and SAT scores*. Rockville, MD: Montgomery County Public Schools.
- Von Secker, C. (2009). *Closing the gap: Seven keys to college readiness for students of all races/ethnicities*. Rockville, MD: Montgomery County Public Schools.
- Wimberly, G. L., & Noeth, R. J. (2005). *College readiness begins in middle school*. Iowa City, IA: ACT, Inc.

Table A1
Number of MCPS Graduates and Number and Percentage of MCPS Graduates Who Were College Ready in Mathematics
(Unlikely to be Required to Take Remedial Mathematics Courses Upon Entry to College^a) by
Race/Ethnicity and Grade 8 Algebra 1 Status

Graduation Class Race/Ethnicity	All Students			Completed Algebra 1 with a C or Higher by the End of Grade 8			Did Not Complete Algebra 1 with a C or Higher by the End of Grade 8		
	N MCPS Graduates	N College Ready	% College Ready	N MCPS Graduates	N College Ready	% College Ready	N MCPS Graduates	N College Ready	% College Ready
Classes of 2001 to 2004	33,788	15,085	44.6	10,298	9,040	87.8	23,490	6,045	25.7
African American	6,492	948	14.6	666	458	68.8	5,826	490	8.4
Asian American	5,269	3,276	62.2	2,291	2,083	90.9	2,978	1,193	40.1
Hispanic	4,214	601	14.3	430	295	68.6	3,784	306	8.1
White	17,728	10,241	57.8	6,901	6,196	89.8	10,827	4,045	37.4

Note. Results for American Indian students are included with all students but are not reported separately. Algebra 1 status and remedial likelihood are based on data available in MCPS student records.

^a MCPS high school students who earned SAT math scores of 550 or higher were identified as college ready (unlikely to be required to take remedial mathematics courses upon entry to college). Results may underestimate college readiness because some colleges allow students with SAT math scores below 550 to enroll in credit-bearing mathematics courses without remediation.

Table A2
Number of MCPS Graduates and Number and Percentage of MCPS Graduates Who Enrolled in College by
Race/Ethnicity and Grade 8 Algebra 1 Status

Graduation Class Race/Ethnicity	All Students			Completed Algebra 1 with a C or Higher by the End of Grade 8			Did Not Complete Algebra 1 with a C or Higher by the End of Grade 8		
	N MCPS Graduates	N Enrolled in College ^a	% Enrolled in College ^a	N MCPS Graduates	N Enrolled in College ^a	% Enrolled in College ^a	N MCPS Graduates	N Enrolled in College ^a	% Enrolled in College ^a
Classes of 2001 to 2004	33,788	28,607	84.7	10,298	9,761	94.8	23,490	18,846	80.2
African American	6,492	4,997	77.0	666	623	93.5	5,826	4,374	75.1
Asian American	5,269	4,642	88.1	2,291	2,139	93.4	2,978	2,503	84.0
Hispanic	4,214	2,964	70.3	430	399	92.8	3,784	2,565	67.8
White	17,728	15,933	89.9	6,901	6,590	95.5	10,827	9,343	86.3

Note. Results for American Indian students are included with all students but are not reported separately. Algebra 1 status is based on data available in MCPS student records. College enrollment status is based on data obtained from the National Clearinghouse in November 2009. Postsecondary records were not available for all graduates.

^a College enrollment is defined as enrolling in a two- or four-year college within six years after high school graduation.

Table A3
Number of MCPS Graduates and Number and Percentage of MCPS Graduates Who Stayed in College (Persisted) by Race/Ethnicity and Grade 8 Algebra 1 Status

Graduation Class Race/Ethnicity	All Students			Completed Algebra 1 with a C or Higher by the End of Grade 8			Did Not Complete Algebra 1 with a C or Higher by the End of Grade 8		
	N MCPS Graduates	N Persisted in College ^a	% Persisted in College ^a	N MCPS Graduates	N Persisted in College ^a	% Persisted in College ^a	N MCPS Graduates	N Persisted in College ^a	% Persisted in College ^a
Classes of 2001 to 2004	33,788	21,924	64.9	10,298	8,839	85.8	23,490	13,085	55.7
African American	6,492	3,165	48.8	666	531	79.7	5,826	2,634	45.2
Asian American	5,269	3,867	73.4	2,291	1,965	85.8	2,978	1,902	63.9
Hispanic	4,214	1,859	44.1	430	334	77.7	3,784	1,525	40.3
White	17,728	12,991	73.3	6,901	6,001	87.0	10,827	6,990	64.6

Note. Results for American Indian students are included with all students but are not reported separately. Algebra 1 status is based on data available in MCPS student records. College persistence status (remaining in college) is based on data obtained from the National Clearinghouse in November 2009. Postsecondary records were not available for all graduates.

^a College persistence is defined as continued college enrollment even if a degree was not obtained during the six years after high school graduation.

Table A4
Number of MCPS Graduates and Number and Percentage of MCPS Graduates Who Earned a Bachelor's Degree Within Six Years by Race/Ethnicity and Grade 8 Algebra 1 Status

Graduation Class Race/Ethnicity	All Students			Completed Algebra 1 with a C or Higher by the End of Grade 8			Did Not Complete Algebra 1 with a C or Higher by the End of Grade 8		
	N MCPS Graduates	N Earned Degree ^a	% Earned Degree ^a	N MCPS Graduates	N Earned Degree ^a	% Earned Degree ^a	N MCPS Graduates	N Earned Degree ^a	% Earned Degree ^a
Classes of 2001 to 2004	33,788	15,803	46.8	10,298	7,728	75.0	23,490	8,075	34.4
African American	6,492	1,731	26.7	666	438	65.8	5,826	1,293	22.2
Asian American	5,269	2,882	54.7	2,291	1,708	74.6	2,978	1,174	39.4
Hispanic	4,214	845	20.1	430	251	58.4	3,784	594	15.7
White	17,728	10,325	58.2	6,901	5,327	77.2	10,827	4,998	46.2

Note. Results for American Indian students are included with all students but are not reported separately. Algebra 1 status is based on data available in MCPS student records. College degree completion status is based on data obtained from the National Clearinghouse in November 2009. Postsecondary records were not available for all graduates.

^a Degree completion is defined as a bachelor's degree or higher from a four-year institution.