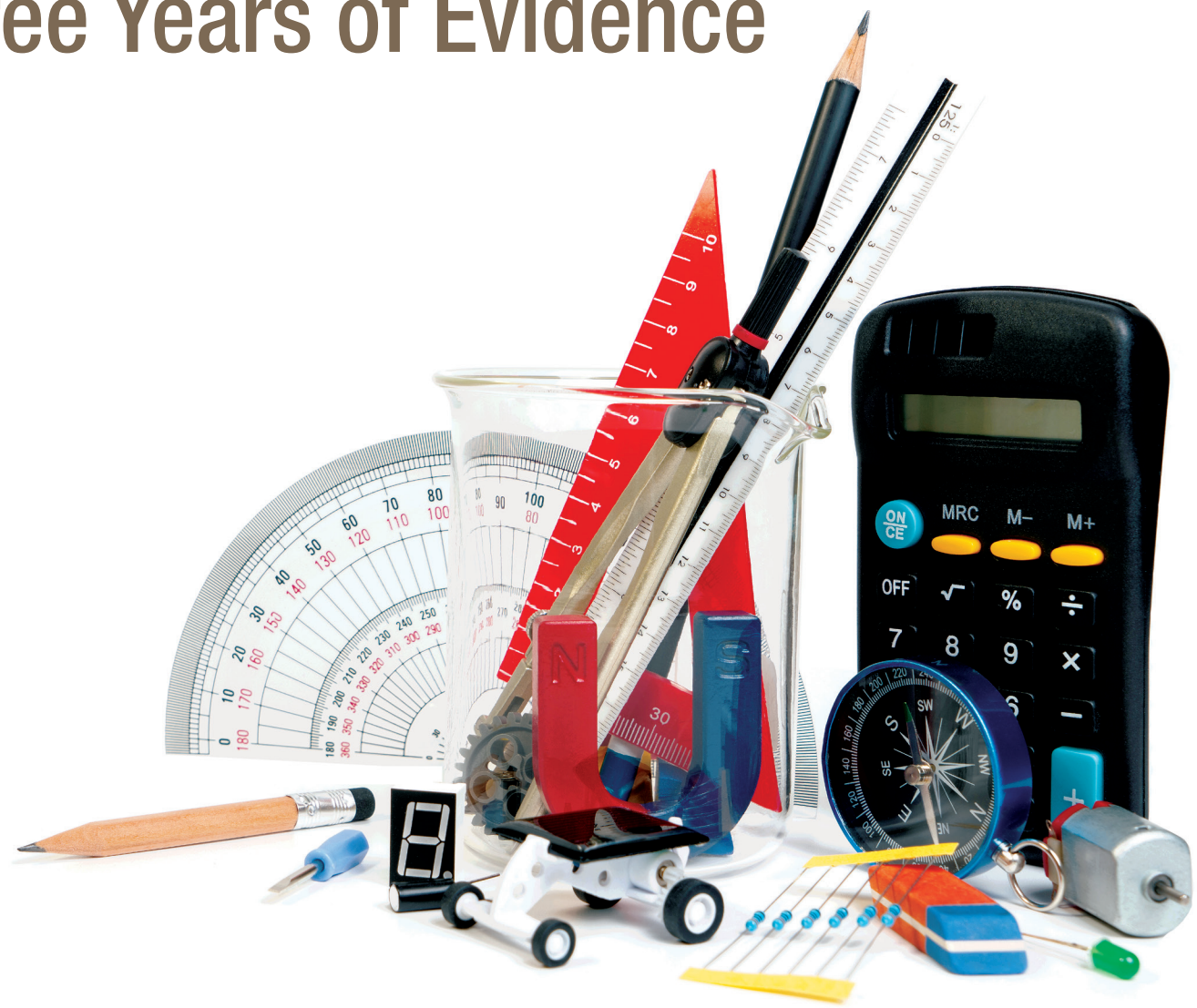
Math Ready

Three Years of Evidence



SREB | Southern Regional Education Board

Contents

The Southern Regional Education Board works with states to improve education at every level, from early childhood through doctoral education. A nonprofit, nonpartisan interstate compact based in Atlanta, SREB was created in 1948 by Southern governors and legislators to help leaders in education and government advance education to improve the social and economic life of the region. Member states are Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia.

This report was prepared by John Squires, program director for College and Career Readiness at SREB.

Introduction

As part of SREB's suite of Readiness Courses, Math Ready was designed to help seniors master math skills before transitioning from high school to postsecondary education and the workplace and avoid costly remediation at the postsecondary level. Schools typically use a state-approved readiness assessment to identify seniors whose scores fall a few points below readiness benchmarks and enroll them in the course. In Math Ready, seniors increase their problem-solving, critical thinking and communication skills to prepare for college-level mathematics course work.

SREB worked with partnering states to develop Math Ready from 2012-14; the course was then made available for implementation in the 2015-16 school year. Since then, Math Ready has been implemented in hundreds of schools around the nation.

Study Overview

This study examines three years of data collected from 35 schools in five states that implemented Math Ready. Two of these states implemented the course in 2015-16 and three states implemented the course in 2016-17. Schools received funds or vouchers to increase the number of students who retook the ACT or the SAT after completing Math Ready. A limitation of this study is that not all Math Ready students chose to retake the ACT or the SAT after completing the course. As such, this study examines data collected for 1,080 Math Ready students in the five states, 366 of whom retook the ACT and 127 of whom retook the SAT after taking Math Ready. In addition to reporting Math Ready students' performance on the ACT and SAT, schools also reported Math Ready course performance data, high school graduation data and college entrance data for all students enrolled in Math Ready. Participating schools included rural, suburban and urban schools that varied in demographics and size. Table 1 summarizes student demographics for this study, with entries rounded to the nearest percentage.

Table 1: Demographics of Math Ready Students

Student Demographics	Percentage (%)
Gender	
Female	54
Male	46
Race/Ethnicity	
African-American	34
White	45
Hispanic	18
Other Race or Ethnicity	3
Income	
Free- or Reduced-Price Lunch	66
Not Free- or Reduced-Price Lunch	34

This study examines the impact of Math Ready on the following student outcomes: (1) Math Ready course performance, (2) performance on the ACT exam before and after taking the course, (3) Math Ready students' performance compared with a comparison group that did not take math during their senior year, (4) Math Ready students' ACT performance in schools that implemented the course for three years, (5) achievement gaps on the ACT exam by gender, race and income, (6) performance on the SAT exam before and after taking the course, (7) high school graduation rates, (8) college entrance rates and (9) results from Math Ready student and teacher surveys administered nationwide at participating schools.

Students with ACT scores higher than 19 are typically considered ready for college and placed into non-remedial courses when they enter postsecondary programs. SREB's Math Ready course was designed to help students who fall a few points below mathematics readiness benchmarks improve their scores and avoid costly remediation at the postsecondary level. This study thus examined only those students in participating schools whose ACT math and science exam scores were less than or equal to 19 (or, in one state, students whose SAT math scores fell within a few points of meeting math readiness benchmarks; see the Note on Methodology, page 10). This sample included students from diverse racial and socioeconomic backgrounds. However, it is important to note that only 10 percent of underserved students in the United States — such as minorities and students from low-income families — show "strong readiness" for college-level course work by meeting at least three of ACT's college readiness benchmarks (ACT, 2018a).

The majority of African-American and Hispanic students have ACT scores below 19, whereas less than 50 percent of white students fall in this range (ACT, 2018b). It is important to examine achievement gaps for students who do not meet college- and career-readiness benchmarks, as any intervention should seek to close or narrow these gaps.

SREB analyzed the ACT math and science scores of Math Ready students. In the case of race or ethnicity, there were insufficient scores in the category of Other Race or Ethnicity to make valid comparisons to other student subgroups.

Student Performance in Math Ready

Math Ready students performed at a high level, with an average numerical grade of 79.9 and a course grade point average of 2.7, where a GPA of 4.0 represents a letter grade of A. Table 2 shows 84 percent of Math Ready students earned a letter grade of C or better, whereas 96 percent received a D or better.

Table 2: Student Performance in Math Ready (*n* = 1,080)

Course	Numerical Grade Average (%)	Average Course GPA (A = 4.0)	Percentage of Students Earning C or Better (%)	Percentage of Students Earning D or Better (%)
Math Ready	79.9	2.7	84	96

Source: SREB analyses of Math Ready student GPA data.

Performance on the ACT Exam

SREB's Math Ready course is designed to increase critical thinking and problem-solving skills. To assess students' attainment of these skills, SREB analyzed Math Ready students' performance on the ACT math and science exams. It is important to note that Math Ready is not an "ACT prep" course; nor does it emphasize rote memorization of concepts.

Table 3 shows that Math Ready students made significant gains on the ACT math and science exams. Among students who showed improvement, the typical gain was 2.1 points on the ACT math exam and 3.3 points on the ACT science exam. The effect size was moderate for the math and science exams.

Table 3: ACT Results of Math Ready Students (*N* = 366)

ACT Exam	Average ACT Score Before Math Ready	Average ACT Score After Math Ready	Improvement in Points	Percentage of Students Who Improved (%)	Typical Student Improvement in Points	Statistically Significant	Effect Size
Math	15.9	16.7	0.8	55	2.1	Yes	0.39
Science	15.5	17.4	1.9	69	3.3	Yes	0.64

Source: SREB analyses of ACT scores for 366 students in 27 high schools who were enrolled in Math Ready and retook the ACT after completing the course.

Math Ready Students Versus a Comparison Group With No Math During the Senior Year

One of the states participating in this study does not require students to complete four years of math in high school. As such, SREB compared Math Ready students in the state to a demographically similar comparison group of students who did not take math during their senior year and who also retook the ACT.

SREB compared ACT math scores of Math Ready students to students who did not take a math course in their senior year. As Table 4 shows, comparison group students had higher ACT math scores before their senior year than Math Ready students; the gap was significant. However, comparison group students did not show gains on the math portion of the ACT exam when they retook it in their senior year. In fact, comparison group students' scores decreased slightly, although not by a statistically significant amount. Math Ready students had higher retake ACT scores than students who did not take math during their senior year. And the gains made by Math Ready students were larger than for students who did not take math during their senior year by a significant margin.

Table 4: Math Ready Students Versus Comparison Group – Performance on the ACT Math Exam (*N* = 71)

ACT Exam Takers	Average Initial ACT Score	Average Retake ACT Score	Improvement in Points	Percentage of Students Who Improved (%)	Typical Student Improvement in Points	Statistically Significant
Math Ready Students (*n* = 51)	16.0	16.8	0.8	59	2.3	Yes
No Math Senior Year (*n* = 20)	16.8	16.3	- 0.5	25	2.0	No

Source: SREB analyses of ACT data from a comparison group of students who did not take math during their senior year and Math Ready students from the same state.

Performance in Schools Implementing Math Ready for Three Years

Data were collected from six schools that implemented Math Ready for three years, beginning in 2015-16. Although results varied from year to year, Tables 5, 6 and 7 show sustained improvement and statistically significant gains on the ACT math and science exams for Math Ready students.

Table 5: Year 1 (2015-16; *N* = 92)

ACT Exam Takers	Average ACT Score Before Math Ready	Average ACT Score After Math Ready	Improvement in Points	Statistically Significant	Effect Size
Math	15.9	16.9	1.0	Yes	0.62
Science	15.6	17.8	2.2	Yes	0.85

Source: SREB analyses of ACT scores for Math Ready students in six schools that implemented Math Ready for three years.

Table 6: Years 2 and 3 (2016-17 and 2017-18; *N* = 115)					
ACT Exam Takers	Average ACT Score Before Math Ready	Average ACT Score After Math Ready	Improvement in Points	Statistically Significant	Effect Size
Math	15.9	17.0	1.1	Yes	0.57
Science	15.5	17.1	1.6	Yes	0.53

Source: SREB analyses of ACT scores for Math Ready students in six schools that implemented Math Ready for three years.

Table 7: Aggregate Data for Years 1 – 3 (2015-16 to 2017-18; *N* = 207)					
ACT Exam Takers	Average ACT Score Before Math Ready	Average ACT Score After Math Ready	Improvement in Points	Statistically Significant	Effect Size
Math	15.9	16.9	1.0	Yes	0.59
Science	15.6	17.4	1.8	Yes	0.67

Source: SREB analyses of ACT scores for Math Ready students in six schools that implemented Math Ready for three years.

Achievement Gaps by Gender, Race and Income

Achievement gaps on the ACT based on gender, race and income have been well-established. On the ACT math and science exams, males typically perform better than females (Perry, 2016); low-income students have lower scores than their peers from higher income households (Mattern, Radunzel & Harmston, 2016); and African-American and Hispanic students have lower scores than white students (Laird & Gehring, 2016). Hence, any closing or narrowing of achievement gaps on the ACT math and science exams should be identified as meaningful progress, whereas persistent gaps should be noted.

Performance on the ACT Exam by Gender

Female and male Math Ready students both made gains on the ACT math and science exams, but the gains between each group of students varied. The gaps were not significant before students took the Math Ready course, and that remained the case after students took the course. As Table 8 indicates, gender was not a factor in determining performance on the ACT math and science exams for Math Ready students.

Table 8: Math Ready Students' Performance on the ACT by Gender (*N* = 366)				
Statistical Measure	Female Students (*n* = 217)	Male Students (*n* = 149)	Female/Male Gap	Statistically Significant
ACT Math				
ACT Math Score Before Math Ready	15.8	16.1	- 0.3	No
ACT Math Score After Math Ready	16.5	16.8	- 0.3	No
Improvement	0.7	0.7	0.0	

Source: SREB analyses of ACT scores for Math Ready students.

Table 8: Math Ready Students' Performance on the ACT by Gender (*N* = 366) – Continued				
Statistical Measure	**Female Students (*n* = 217)**	**Male Students (*n* = 149)**	**Female/Male Gap**	**Statistically Significant**
ACT Science				
ACT Science Score Before Math Ready	15.6	15.4	0.2	No
ACT Science Score After Math Ready	17.4	17.4	0.0	No
Improvement	1.8	2.0	-0.2	

Source: SREB analyses of ACT scores for Math Ready students.

Performance on the ACT Exam by Race

When examining achievement gaps on the ACT exam by race, data showed all student groups made gains after taking Math Ready, but improvement varied among groups. Significant gaps between the groups persisted on the ACT math exam, while gaps were narrowed on the ACT science exam after taking Math Ready. There were insufficient scores in the Other Race or Ethnicity category to make valid comparisons to the other student subgroups. Results are summarized in Tables 9, 10 and 11.

Table 9: Math Ready Students' Performance on the ACT by Race – African-American and White (*N* = 315)				
Statistical Measure	**African-American Students (*n* = 151)**	**White Students (*n* = 164)**	**African-American/ White Gap**	**Statistically Significant**
ACT Math				
ACT Math Score Before Math Ready	15.6	16.3	- 0.7	Yes
ACT Math Score After Math Ready	16.0	17.2	- 1.2	Yes
Improvement	0.4	0.9	- 0.5	
ACT Science				
ACT Science Score Before Math Ready	15.3	15.9	- 0.6	Yes
ACT Science Score After Math Ready	17.3	17.6	- 0.3	No
Improvement	2.0	1.7	0.3	

Source: SREB analyses of ACT scores for Math Ready students.

Table 10: Math Ready Students' Performance on the ACT by Race – African-American and Hispanic (*N* = 195)				
Statistical Measure	**African-American Students (*n* = 151)**	**Hispanic Students (*n* = 44)**	**African-American/ Hispanic Gap**	**Statistically Significant**
ACT Math				
ACT Math Score Before Math Ready	15.6	15.7	- 0.1	No
ACT Math Score After Math Ready	16.0	16.8	- 0.8	Yes
Improvement	0.4	1.1	- 0.7	
ACT Science				
ACT Science Score Before Math Ready	15.3	14.6	0.7	No
ACT Science Score After Math Ready	17.3	16.6	0.7	No
Improvement	2.0	2.0	0.0	

Source: SREB analyses of ACT scores for Math Ready students.

Table 11: Math Ready Students' Performance on the ACT by Race – Hispanic and White (*N* = 208)				
Statistical Measure	**Hispanic Students (*n* = 44)**	**White Students (*n* = 164)**	**Hispanic/White Gap**	**Statistically Significant**
ACT Math				
ACT Math Score Before Math Ready	15.7	16.3	- 0.6	Yes
ACT Math Score After Math Ready	16.8	17.2	- 0.4	No
Improvement	1.1	0.9	0.2	
ACT Science				
ACT Science Score Before Math Ready	14.6	15.9	- 1.3	Yes
ACT Science Score After Math Ready	16.6	17.6	- 1.0	No
Improvement	2.0	1.7	0.3	

Source: SREB analyses of ACT scores for Math Ready students.

Performance on the ACT Exam by Family Income

When examining performance by income, both student groups made gains on the ACT math and science exams after taking the Math Ready course, but the gains between groups varied. As Table 12 shows, students receiving free- and reduced-price lunch, a proxy for low socioeconomic status, scored significantly lower than their peers on the ACT math exam, perpetuating

a gap that existed before Math Ready. On the ACT science exam, students who received free- or reduced-price lunch made larger gains and narrowed a significant gap after taking Math Ready.

Table 12: Math Ready Students' Performance on the ACT by Family Income (*N* = 366)

Statistical Measure	Free- and Reduced-Price Lunch (*n* = 258)	Not Free- and Reduced-Price Lunch (*n* = 108)	Free- and Reduced-Price Lunch/Not Free- and Reduced-Price Lunch Gap	Statistically Significant
ACT Math				
ACT Math Score Before Math Ready	15.8	16.2	- 0.4	Yes
ACT Math Score After Math Ready	16.5	17.0	- 0.5	Yes
Improvement	0.7	0.8	- 0.1	
ACT Science				
ACT Science Score Before Math Ready	15.3	16.1	- 0.8	Yes
ACT Science Score After Math Ready	17.2	17.8	- 0.6	No
Improvement	1.9	1.7	0.2	

Source: SREB analyses of ACT scores for Math Ready students.

Student Performance on the SAT Math Exam

Eight schools in one of the participating states had their students take the SAT exam after taking Math Ready. Math Ready is designed to increase problem-solving and critical thinking skills and cannot be considered an "SAT prep" course. Nor does Math Ready emphasize rote memorization.

Similar to the performance on the ACT exam, students in Math Ready also showed improvement on the SAT math exam; gains were statistically significant. As Table 13 shows, 69 percent of Math Ready students improved their scores on the SAT math exam. Among students who showed improvement, the typical gain was 47.3 points in math. The effect size was moderate on the SAT math exam.

Table 13: Math Ready Students' Performance on the SAT Math Exam (*N* = 127)

SAT Exam	Average SAT Score Before Math Ready	Average SAT Score After Math Ready	Improvement in Points	Percentage of Students Who Improved (%)	Typical Student Improvement in Points	Statistically Significant	Effect Size
Math	412.4	436.6	24.2	69	47.3	Yes	0.52

Source: SREB analyses of SAT scores for 127 students in eight high schools who were enrolled in Math Ready and retook the SAT after completing the course.

High School Graduation Rates

SREB collected data on high school graduation rates from each of the schools participating in this study for Math Ready students. Overall, Math Ready students had a 97 percent graduation rate. In each of the five states, the high school graduation rate for Math Ready students was higher than the rate reported for all students at the participating high schools. This promising finding warrants further study.

College Entrance Rates

Information on college entrance rates was collected from the six schools that implemented Math Ready starting in 2015-16. Math Ready students had a 70 percent college entrance rate at these schools. These promising data suggest that further study is needed of the impact of Math Ready on college entrance. The other schools participating in this study reported data for students from 2017-18. As such, college entrance data were not available for this report.

Course Surveys

SREB administers a survey to all teachers and students nationwide who participate in Math Ready. These surveys are used to gather information about teacher and student experiences as well as the quality of the course materials. Table 14 reflects responses for selected questions from all schools offering Math Ready in 2016-17 and 2017-18, including schools that did not participate in this study. Table 14 presents average responses on a 4-point Likert-type scale.

Table 14: Teacher and Student Survey Responses (*n* = 1,853 students, 174 teachers)

Survey Question	Student Responses	Teacher Responses
Students take responsibility for their own learning.	3.4	2.7
Math Ready is preparing students for college-level course work.	3.0	2.9
Taking Math Ready has impacted the way I learn.	2.9	--
Taking Math Ready has impacted the way I teach.	--	2.8

Source: Student and teacher response data from SREB Readiness Course surveys collected in 2016-17 and 2017-18. Average responses are provided on a 4-point Likert-type scale.

The following comments were representative of Math Ready students who took the survey:

> "I'm learning more with this program than I have in years past with a more traditional approach."

> "It is easily the best math course I've ever taken."

Math Ready teachers who took the survey made comments like the following:

> "Students have told me it's the hardest they have ever worked in a math class...but the most fun they have ever had."

> "The curriculum is challenging but adequate to prepare seniors for college math."

Summary

As noted in the Study Overview (see page 1), SREB's sample was limited to a small number of states and only those Math Ready students who chose to retake the ACT or the SAT after completing the course. As such, this study's findings should be seen as preliminary. However, the data collected over a three-year period indicate that Math Ready students performed well in the course and improved their scores on the ACT math and science exams after taking the course. Schools that implemented Math Ready for three years showed sustained gains on the ACT math and science exams. When looking at performance on ACT's math and science exams, all student subgroups showed improvement, but the amount of the improvement varied between groups. On the ACT math exam, gender gaps did not exist, whereas race and income gaps did exist. On the ACT science exam, there were no significant gaps based on gender, race or income. Data on high school graduation and college entrance rates are promising but not definitive. Surveys indicate that the Math Ready course is well-received by both students and teachers. Overall findings showed the following:

- **Course performance.** Students in Math Ready performed at a high level, with an average numerical grade of 79.9 and an average course GPA of 2.7, where 4.0 represents a grade of A.
- **Performance on the ACT math and science exams.** Students showed significant improvement on the ACT math and science exams, with the average score increasing by 0.8 points and 1.9 points, respectively. Effect sizes were moderate for the math and science exams.
- **Comparison group analyses.** A comparison group of students who did not take math during their senior year in high school was identified in one state. These students did not make gains on the ACT math exam, whereas Math Ready students from the same state made significant gains on the ACT math exam after taking the course.
- **Schools implementing Math Ready for three years.** Data collected from six schools that implemented the course for three years revealed sustained, significant gains on the ACT math and science exams, with a moderate effect size on both exams.
- **Achievement gaps on the ACT exam.** Achievement gaps on the ACT math and science exams based on gender, race and income are well-documented. When looking at performance on the ACT exam for Math Ready students, all groups showed improvement on the math and science exams, but the amount of the improvement varied between groups. On the ACT math exam, gender gaps did not exist, whereas race and income gaps did exist. On the ACT science exam, there were no significant gaps based on gender, race or income.
- **High school graduation rates.** The data collected from each of the participating schools indicated that 97 percent of Math Ready students graduated from high school.
- **College entrance rates.** Data collected from the six schools that implemented Math Ready in 2015-16 showed that 70 percent of Math Ready students enrolled in college.
- **Student and teacher surveys.** Course surveys indicate that Math Ready is well-received by both students and teachers, as evidenced by both survey responses and comments. Students report a high level of self-efficacy after taking Math Ready.

Future Studies

SREB recommends that additional longitudinal studies be conducted in two areas. First, although evidence regarding the impact of Math Ready on high school graduation is limited, further study in this area is merited. Second, the effects on remediation and performance in college should be examined as Math Ready students move from high school into postsecondary education.

Bibliography

ACT. (2018a). *The condition of college and career readiness*. Iowa City, IA: Author. www.act.org/condition2018.

ACT. (2018b). *Profile report: National*. Iowa City, IA: Author. www.act.org/content/dam/act/unsecured/documents/cccr2018/P_99_999999_N_S_N00_ACT-GCPR_National.pdf

Laird, M., & Gehring, C. (2016). *A decade of ACT data by race/ethnicity.* Baton Rouge, LA: MasteryPrep. https://masteryprep.com/act-race-ethnicity-data/.

Mattern, K., Radunzel, J., & Harmston, M. (2016). *ACT composite score by family income*. Iowa City, IA: ACT. www.act.org/content/dam/act/unsecured/documents/R1604-ACT-Composite-Score-by-Family-Income.pdf.

Perry, M. (2016). *Gender differences on the ACT test: Boys score higher on math and science; girls score higher on English and reading*. Washington, DC: American Enterprise Institute. www.aei.org/publication/gender-differences-on-the-act-test-boys-score-higher-on-math-and-science-girls-score-higher-on-english-and-reading/.

Note on Methodology

This study was designed as a quasi-experimental analysis using paired *t*-tests to measure ACT gains, independent samples *t*-tests to identify achievement gaps based on gender and income, and an ANOVA test to determine achievement gaps based on race. For the ANOVA, Levene's test was used to test the homogeneity of variances, and Tukey's Honestly Significant Difference test was used for post hoc pairwise tests. To determine the effect size on paired *t*-tests, Cohen's *d* was calculated. All statistical tests were set at a 95 percent level of significance. Statistical analyses were not performed on groups with less than 10 students. Throughout this study, the terms *significant* and *statistically significant* indicate the application of a statistical test with $p < .05$.

19V07w
MARCH 2019

SREB

592 10th St., N.W.
Atlanta, GA 30318-5776
(404) 875-9211