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Math Readiness for College and Career in South Carolina

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Background

Preparing students to be college and career ready is a persistent challenge for educators and leaders across the U.S. (Petcu et al., 2016). Frequently, industries with the largest gains in job growth require some form of postsecondary education, which is also crucial in providing students access to higher-paying careers (Lockard & Wolf, 2012). However, both nationally and locally, the proportion of students who are prepared for college and career is often small (Achieve, 2012). Moreover, without clear and accessible paths to success, students are less likely to complete college or gain the skills and training necessary for a career (McCarron & Inkelas, 2006; Pusser & Levin, 2009).

Mathematics proficiency is a crucial and foundational aspect of college and career success. Math skills are required in the study of many disciplines and are necessary to begin college, enter job training programs, or pursue a career in the military (Achieve, 2017). Because of the widespread importance of math readiness, conversations and initiatives at national and state levels have frequently focused on this critical issue, including through policies, key student success indicators, and K-12 curricula development. Despite multiple efforts to improve math proficiency, in 2019, only 39% of students nationwide were considered college ready in math based on scores from the ACT, a widely used assessment of college readiness (ACT, 2019).

Unpreparedness in math has resulted in colleges and universities requiring a substantial proportion of students to enroll in some form of remedial, or developmental, coursework. Remediation speaks to a larger, pervasive under-preparedness for both college and career. Particularly, inadequate math preparation often disproportionately impacts students from groups that have been historically minoritized in higher education (Fletcher & Tienda, 2010). Often, these achievement and articulation gaps encourage educators and administrators to engage in tracking or funneling based on perceived ability, students into college-preparatory or career-oriented coursework. Evidence of tracking is especially evident in math coursework, which can be detrimental to minoritized students, as these processes and practices perpetuate and exacerbate learning disparities (McPhail, 2017).

Recent research has demonstrated that there are substantial differences in institutionally designated metrics of success and college and career readiness among racial/ethnic and socioeconomic groups (White House Task Force on the Middle Class, 2010; Zaber & Hamilton, 2020). Students belonging to minoritized and impoverished communities continue to be unsupported while enrolled in higher education, thus, frequently leaving school, and completing postsecondary credentials at low rates (Cahalan et al.,

2020). Specifically, in South Carolina (SC), although several state- and institutional-level initiatives and supports are available (Educational Policy Improvement Center [EPIC], 2015; Hoffman et al., 2018; Petcu et al., 2016; Young et al., 2017), statewide trends indicate that achievement gaps by race/ethnicity and socioeconomic status appear early and worsen as students' progress through their education (U.S. Department of Education, n.d). Ultimately, it is imperative for the overall well-being of SC citizens for educators, educational leaders, and policymakers to consider what it means to be college and career ready, how institutions can create and deliver supports to all students, and how educators at all levels can engage in a process of continuous monitoring and improvement of these efforts.

In addition to highlighting the existence of disparities in student outcomes and success, it is important to acknowledge the context surrounding these issues. The time at which this report was finalized represented a much different time than when it was conceptualized. In 2020, the state, country, and world faced major social challenges that had significant impacts on education. There is no doubt that the COVID-19 pandemic has had irreversible effects on society's major institutions, including government, business, and education. For instance, in fall 2020, classes and other educational offerings had to move from in-person to distance learning formats. Additionally, the murder of George Floyd, Breonna Taylor, and several other Black citizens in 2020 raised increased awareness of systemic racism that has been at the root of deep and persistent inequality nationwide. Because of inequities across the country and in the state of SC, many students – particularly those in rural or low-income areas – have been deprived of educational opportunities because of limited institutional assistance, including access to technology, broadband internet, and support services (Berg, 2020; Dorn et al., 2020; McKenzie, 2020). In addition, events, such as internships and other work-based learning experiences, have been reconfigured or canceled altogether. Disparities are only expected to increase as schools are required to conduct all or even some of their business online. These events underscore that an equity-minded approach is necessary to support all students for long-term educational success.

The pandemic and social unrest only spotlight issues that have existed for decades. It is against this backdrop that we present this report on math readiness in South Carolina. We use a racial- and equity-minded framework to explore disparities in educational success and attainment among SC students and to determine the extent of equity in SC educational practices and policies.

Purpose and Organization of the Report

The purpose of this report is to identify, describe, and examine math readiness in South Carolina (SC), highlighting how educators and state policies can prepare students for college and career. It is important to acknowledge that the primary focus of the report is descriptive to provide information about the landscape of math readiness in the state. As such, while some interpretation is presented, particularly around present racial and equity concerns, we did not make inferences about the broad extent of forces that have brought SC to its current state.

The report presents information about definitions of math readiness in SC, measures math readiness in the state, and details what is happening in the state to prepare students to be math ready. The report then concludes with a brief examination of what we learned about math readiness in SC, offering considerations for policy, practice, and future research.

The information in the report is presented in sections guided by the following questions:

- What does it mean to be math ready in SC?
- How is math readiness measured in SC?
- What is SC doing to prepare students to be math ready for college and career?

Guiding Approach: Racial and Equity-Minded Framework

In this report, we used racial- and equity-minded framework to explore math readiness for college and career among students in SC. This approach allowed us to explore and to highlight any disparities in the educational experiences and opportunities students face, particularly those from racial/ethnically minoritized populations and low socioeconomic statuses (SES) (Center for Urban Education, 2017). Given that previous data has identified gaps in success by SES and race, we find it imperative to look at math readiness overall with this framework. Specifically, we collected data that allowed us to determine the “dynamic relationship among race, power, and identities” and to “actively [name] and [address] any hidden contributors to inequity” (Garces & Gordon da Cruz, 2017, p. 324). We examined student success outcomes and the role of institutional practices and responsibilities in these outcomes (Bensimon, 2005). Examples of these outcomes included state math readiness standards, teacher preparation and licensure requirements, math testing indicators, and college readiness indicators. We then described the implications that disparities in student access and achievement may have for South Carolina students’ college and career readiness.

What Does it Mean to Be Math Ready in South Carolina?

South Carolina has undertaken several initiatives to prepare students to be math ready for their post-secondary pursuits, including college and careers (see Educational Policy Improvement Center, 2015; Petcu et al., 2016; Young et al., 2017). To understand the context in which these initiatives are created and carried out, we describe how educators and policymakers across the U.S. and SC define, perceive, and implement ideas of what it means to be ready for college and careers, both broadly as well as specifically, and proficient in math.

Common Elements of State CCR Definitions

The College and Career Readiness and Success Center (CCRS) at the American Institutes for Research examined state-level CCR definitions and identified common elements (Mishkind, 2014), which included:

- Academic knowledge
- Critical thinking and/or problem-solving skills, such as analysis, inference, and evaluation
- Social and emotional traits, such as collaboration, social awareness, and responsible decision-making
- Intrapersonal skills, such as grit, resilience, and perseverance
- Citizenship and/or community involvement
- Other employability skills

Defining College and Career Readiness

Several researchers and national organizations have offered varying definitions of college and career readiness (CCR). As states continue to position CCR at the center of their educational strategies, many have built on these general definitions to create state-level definitions tailored to their individual goals and contexts. At least 36 states have adopted CCR definitions that describe the knowledge, skills, and experiences that students need to be ready for college and career (Mishkind, 2014).

When states create actionable definitions for CCR, educators, district leaders, and policymakers can identify steps to achieve objectives intended to prepare students for success for multiple paths beyond high school. Stakeholders, ranging from individual teachers in classrooms, to district curriculum specialists, to educators working at the state board of education, may find these definitions useful as they develop and identify measures for CCR (Mishkind, 2014). Moreover, measures can be used to determine how CCR efforts work for each student population and adjust approaches accordingly.

One definition used widely in shaping the policy and practice of supporting CCR in SC is that put forward by Conley (2007), whose work is foundational in several state-wide CCR initiatives; these include the SC Course Alignment Project (Chadwick et al., 2014), which aligns courses in high schools and colleges in the state with the elements of his definition, and the establishment of the SC Center of Excellence for College and Career Readiness (EPIC, 2015). Following these ideas, the next section describes how College and Career Readiness has been operationalized in South Carolina.

Conley's (2007) Four Keys to College and Career Readiness

Four elements that are critical to students' achievement in and after high school:

1. Key cognitive strategies
 - Problem solving, inquisitiveness, precision/accuracy, interpretation, reasoning, research, and intellectual openness
2. Key content knowledge
 - Attitudes toward learning, technical knowledge and skills, retaining and applying knowledge
3. Key learning skills and techniques
 - Self-monitoring, studying skills, ownership of learning
4. Key transition knowledge and skills
 - Contextual, procedural, financial, cultural, and personal understanding leading to goal attainment and navigation of pathways to success

Conceptualizing College and Career Readiness in South Carolina

In their review of state-level definitions of college and career readiness, the College and Career Readiness and Success Center at the American Institutes for Research CCRS reported that SC was among states that had not adopted or made available a definition of college and career readiness (CCRS, n.d.; Mishkind, 2014; Petcu et al., 2016). Although there is no official definition of CCR for the state, SC utilizes the *Profile of the SC Graduate*, developed by the SC Association of School Administrators Superintendents' Roundtable and widely promoted by TransformSC, a coalition of education and business leaders. The *Profile of the SC Graduate* was subsequently adopted by key groups in South Carolina, including the SC State Board of Education, the SC Department of Education, and the SC Chamber of Commerce, thereby making it the de facto definition for the state. The *Profile* was designed to provide educators and administrators a framework to use to prepare for today's competitive workforce. Upon examining elements of the *Profile*, it is evident that the state's conceptualization of student success is centered around students' actions and efforts taken toward success. The *Profile* does not address nor considers the structural, social, and economic conditions and inequalities that impact students' experiences and skill development.

Profile of the South Carolina Graduate

1. World Class Knowledge
 - Achievement in math; English language arts; science, technology, engineering, and math; arts; multiple languages; and social sciences
2. World Class Skill
 - Creativity and innovation, critical thinking and problem solving, collaboration and teamwork, communication, and media and technology, and knowing how to learn
3. Life and Career Characteristics
 - Integrity, self-direction, global perspective, perseverance, work ethic, and interpersonal skills

Defining Math Readiness in South Carolina

Previous conceptualizations of CCR demonstrate the importance of math and quantitative reasoning for a student's success after high school (EPIC, 2015; Mishkind, 2014). Moreover, definitions have called for math-related skills that go beyond the mechanics and knowledge of discrete mathematical principles, including analysis, inference, and critical thinking and problem-solving.

Math Standards

In 2015, South Carolina adopted CCR standards for mathematics. The *South Carolina College- and Career-Ready Standards (SCCCR) for Mathematics* contains standards for mathematics that both represent conceptual and procedural knowledge and specify the specific math knowledge that students will master in each grade level and high school course. These standards also contain a cumulative set of graduation standards that outline mathematics knowledge that high school students should attain to be ready for both college and career. These standards were developed and drafted to align the characteristics outlined in the *Profile of the SC Graduate*.

In addition to the content standards for each grade level, high school course, and graduation, the SCCCR for Mathematics contains goals and activities associated with achieving state-defined mathematics competency. These were developed in alignment with Common Core standards (Common Core, 2020) and include the following:

- Making sense of problems and persevere in solving them.
- Reasoning both contextually and abstractly.
- Using critical thinking skills to justify mathematical reasoning and critique the reasoning of others.
- Connecting mathematical ideas and real-world situations through modeling.
- Using a variety of mathematical tools effectively and strategically.
- Communicating mathematically and approach mathematical situations with precision.
- Identifying and utilizing structure and patterns.

The South Carolina Department of Education (SCDE) also utilizes a framework presented in the *Portrait of a College and Career-Ready Mathematics Student* (SCDE, 2015), which articulates mathematical skills that a college-

The South Carolina Department of Education (SCDE, 2015) determined that the following eight courses would be offered to high school students to prepare them to meet math readiness objectives:

1. Algebra 1
2. Foundations in Algebra
3. Intermediate Algebra
4. Algebra 2
5. Geometry
6. Probability and Statistics
7. Pre-Calculus
8. Calculus

and career-ready graduate should be able to demonstrate, including:

- Academic success and employability
- Interdependent thinking and collaborative spirit
- Intellectual integrity and curiosity
- Logical reasoning
- Self-reliance and autonomy
- Effective communication

What All This Means for Math Readiness in South Carolina

As stakeholders across the state crafted definitions of college and career readiness, they described the important role math readiness plays in the ongoing success of South Carolina students. Broad definitions have been aligned with standards for process and learning outcomes for students, as well as the subsequent courses that are designed to achieve these objectives. As educators across the state continue to develop and implement mathematics curricula, it is important that researchers and practitioners alike gather and examine data that will determine the extent to which associated goals are achieved and how efforts can be improved to provide students tailored support so that they may succeed.

South Carolina College and Career Readiness Mathematics Standards by Course

The state's math courses were created for students to build on their knowledge in previous courses, to expand their mathematics knowledge, and to deepen their conceptual understanding of math to prepare students for college and career (SCCCR, 2015). The SCCCR math standards covered in these courses include:

- Algebra
 - » Arithmetic with Polynomials and Rational Expressions
 - » Creating Equations
 - » Reasoning with Equations and Inequalities
 - » Structure and Expressions
- Functions
 - » Building Functions
 - » Interpreting Functions
 - » Linear, Quadratic, and Exponential
 - » Trigonometry
- Geometry
 - » Circles
 - » Congruence
 - » Geometric Measurement and Dimension
 - » Expressing Geometric Properties with Equations
 - » Modeling
 - » Similarity, Right Triangles, and Trigonometry
- Number and Quantity
 - » Quantities
 - » Real Number System
 - » Complex Number System
 - » Vector and Matrix Quantities
- Statistics and Probability
 - » Conditional Probability and Rules of Probability
 - » Making Inferences and Justifying Conclusions
 - » Interpreting Data
 - » Using Probability to Make Decisions
- Calculus
 - » Limits and Continuity
 - » Derivatives
 - » Integrals

How Is Math Readiness Measured in South Carolina?

South Carolina employs several measures that indicate students’ proficiency in mathematics, and these efforts begin early in students’ educational careers. We present several math indicators that the state uses to assess students’ math readiness in the below sections. Because math competency and readiness development begin earlier than high school, we present two views of math readiness indicators. The first is a set of early math readiness indicators, including those in 4th and 8th grades. We then provide an overview of the state’s primary measures for determining math readiness at the end of high school. Moreover, where possible, we break down the achievement levels based on race and ethnicity, as well as socioeconomic status to better understand where inequities in math readiness are present in South Carolina.

Early Math Readiness Indicators: National Assessment of Educational Progress

Early college readiness assessments, such as the National Assessment of Educational Progress (NAEP), are common forms of measuring math readiness for college and career across the country, including in South Carolina (Barnett et al., 2013). South Carolina scores for the NAEP are only publicly available for 4th and 8th grade, but the available data indicate that achievement scores declined for South Carolina students between 4th and 8th grade, including a drop between 9 and 15 percentage points in mathematics since 2003 (see Table 1). Scores indicate a decrease in academic readiness for high school as students progress into middle school.

Table 1
Comparison of achievement levels on the National Assessment of Educational Progress on the mathematics section between South Carolina and the US

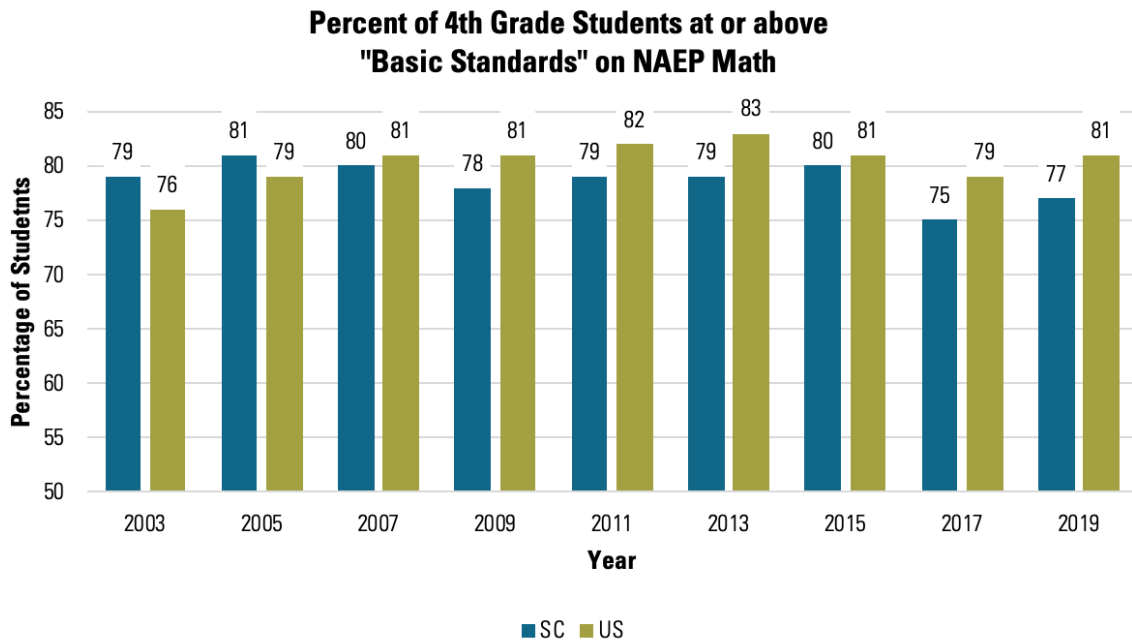
Year	% of 4th Graders at or Above "Basic Standards"		% of 8th Graders at or Above "Basic Standards"		Change in % from 4th to 8th Grade in SC
	US	SC	US	SC	
2003	76	79	67	68	-11
2005	79	81	68	71	-10
2007	81	80	70	71	-9
2009	81	78	71	69	-11
2011	82	79	72	70	-9
2013	83	79	74	69	-10
2015	81	80	70	65	-15
2017	79	75	70	63	-12
2019	81	77	69	64	-13

Data source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

A comparison between the percent of South Carolina students' scores on the NAEP and the overall national percentage reveals a couple of concerning trends. First, since 2003 SC students' performance on the NAEP mathematics section has fallen relative to the overall national profile. In 2003 and 2005, the percentage of 4th and 8th grade students meeting or exceeding "Basic Standards" on

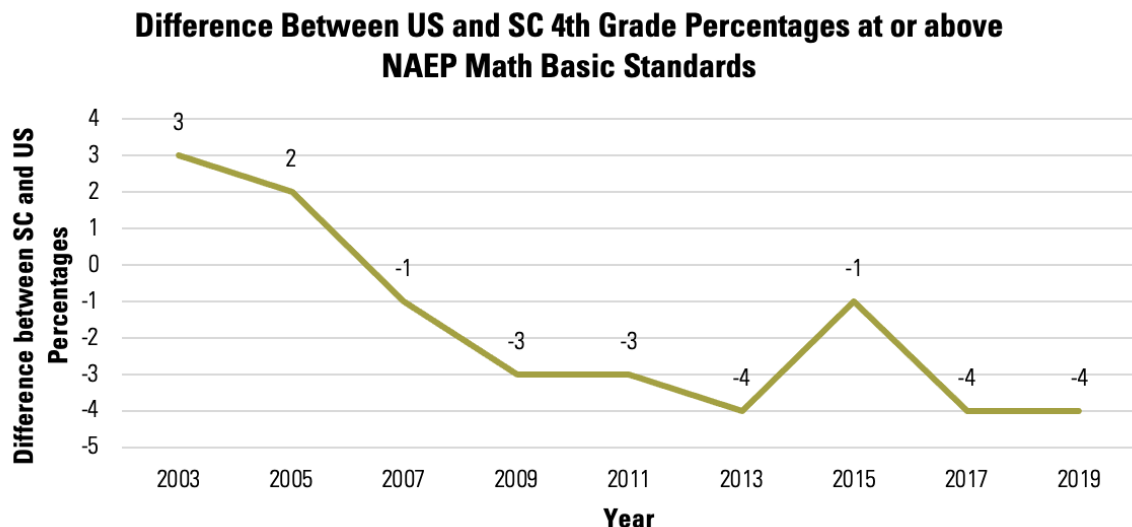
NAEP math was higher than the national percentage (see Figures 1 and 3). However, in every year since 2009, the SC percentage has been lower than the national average (see Figures 2 and 4). Second, the gap between South Carolina and national percentages is not only trending down over time, but there are also signs that it is widening by the time students reach the 8th grade (see Figures 2 and 4).

Figure 1. Comparison of achievement levels of 4th grade students on the National Assessment of Educational Progress on the mathematics section between South Carolina and the US.



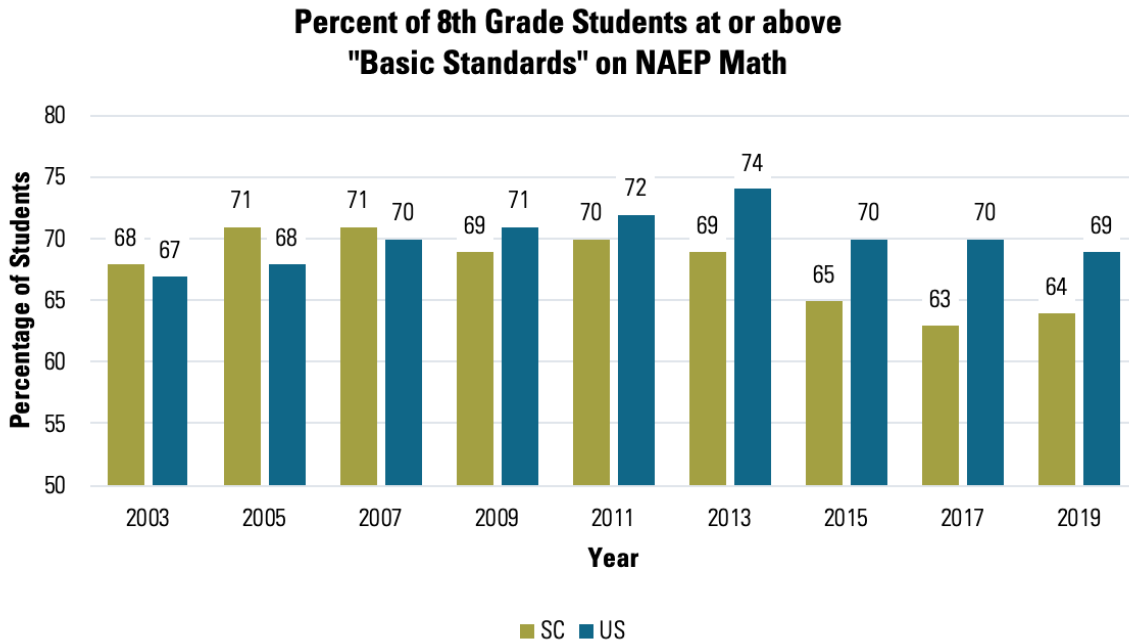
Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Figure 2. The difference in achievement levels of 4th grade students on the National Assessment of Educational Progress on the mathematics section between South Carolina and the US.



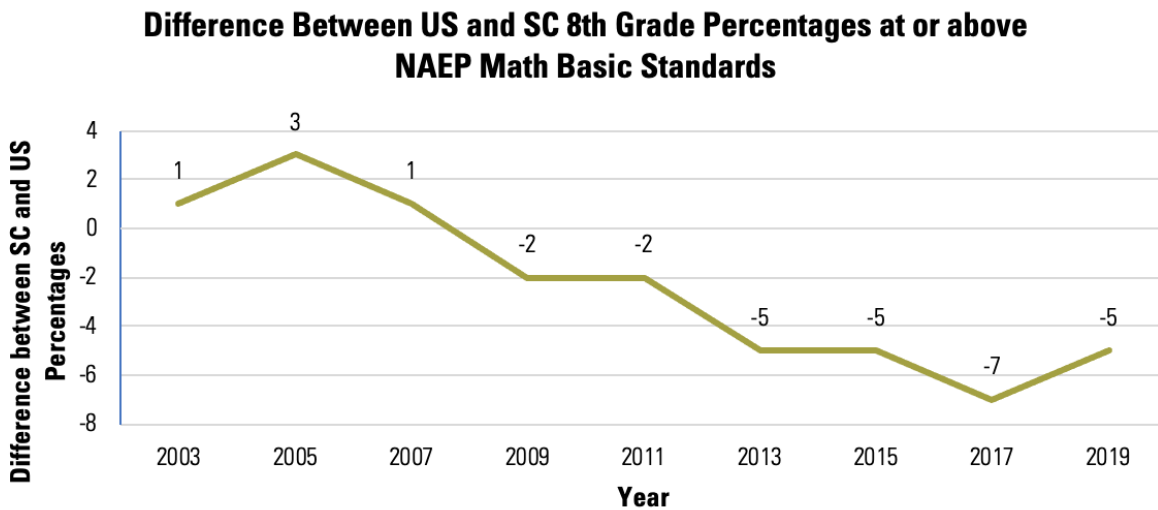
Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Figure 3. Comparison of achievement levels of 8th grade students on the National Assessment of Educational Progress on the mathematics section between South Carolina and the US.



Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Figure 4. The difference in achievement levels of 8th grade students on the National Assessment of Educational Progress on the mathematics section between South Carolina and the US.



Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Moreover, these decreases are not distributed equally among students from racially/ethnically minoritized and low-income groups. The differences between achievement rates in 4th and 8th grades in South Carolina are consistently lower for White students (between six and 12 percentage

points; Table 2) than differences for Black (between 8 and 22 points) or Hispanic students (between 7 and 25 points). This is all on top of the persistent differences in achievement rates between racial and ethnic groups presented in Table 2 and Figure 5.

Table 2

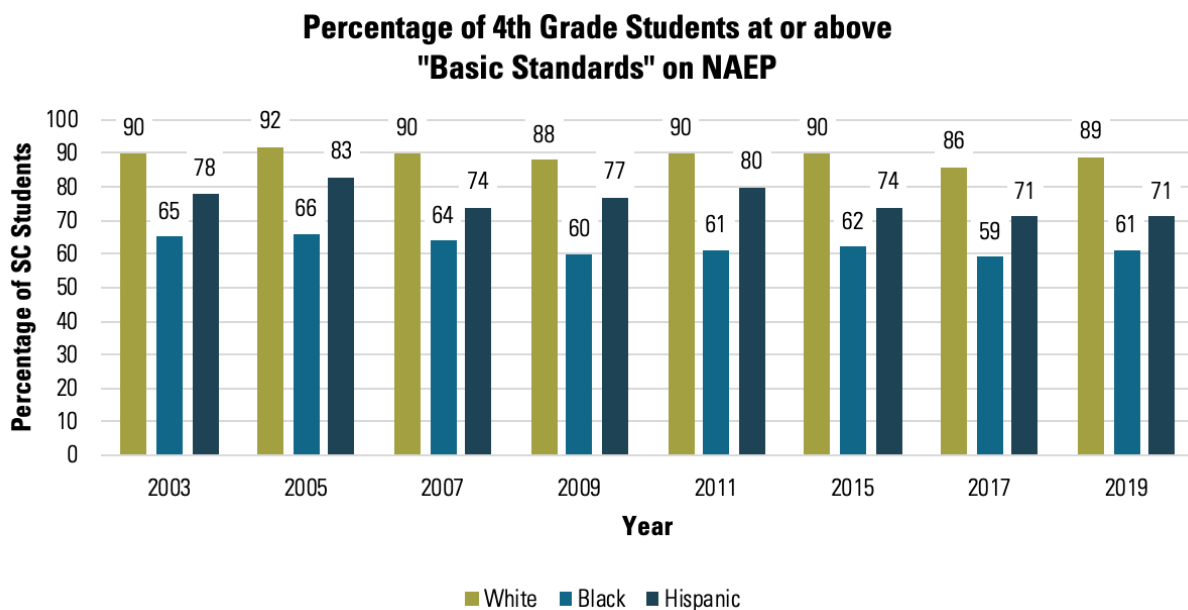
Comparison of achievement levels on the National Assessment of Educational Progress on the mathematics section between racial and ethnic groups in South Carolina

Year	4th grade race at or above basic			8th grade race at or above basic			Change in % from 4th to 8th Grade in SC		
	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
2003	90	65	78	84	46	^a	-6	-19	^a
2005	92	66	83	86	51	58	-6	-15	-25
2007	90	64	74	83	55	62	-7	-9	-12
2009	88	60	77	83	52	57	-5	-8	-20
2011	90	61	80	83	50	63	-7	-11	-17
2015	90	62	74	80	42	62	-10	-20	-12
2017	86	59	71	78	37	64	-8	-22	-7
2019	89	61	71	77	43	58	-12	-18	-13

Data source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

^a Data for Hispanic 8th grade students in 2003 was not available.

Figure 5. Comparison of achievement levels of 4th grade students in South Carolina on the National Assessment of Educational Progress on the mathematics section broken down by race.

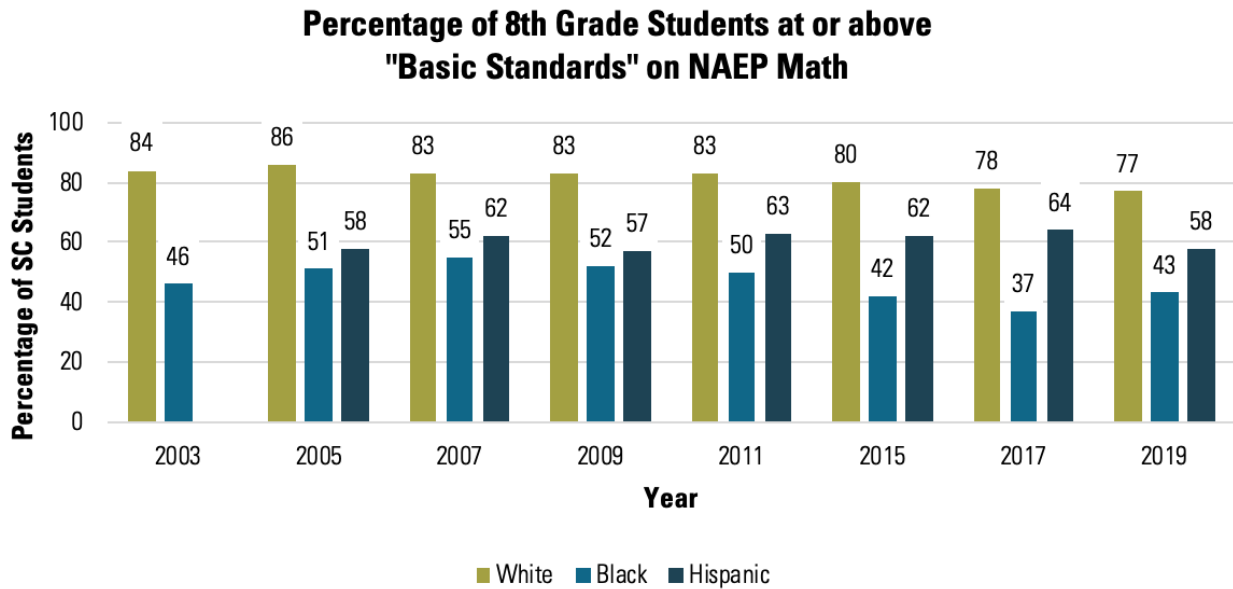


Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

In practical terms, it helps to point to one example: in 2017 there was a 17-point difference between the percentage of Black and White 4th graders in South Carolina who scored at or above “Basic Standards” in math. By 8th grade, not only did the percentage for both groups drop, but the difference between Black and White students grew to 41 points (Figure 6). While this may be an extreme example, it is indicative of a general pattern that there is a racial gap between White and Black students in the 4th grade that widens by the 8th grade. This pattern is also evident between White and Hispanic/Latino students (see Figures 5 and 6).

Similarly, fewer students from lower-income backgrounds meet “Basic Standards” in the NAEP math section compared to other students. Repeating patterns demonstrated earlier, there was a decrease in achievement between 4th and 8th grade (see Figures 7 and 8). However, the decrease was not nearly as pronounced among higher-income students, and it is particularly pronounced among low-income students in the 8th grade. For example, in 2019, 92 percent of 4th graders from higher-income backgrounds were at or above “Basic” in the math section compared to 82 percent of 8th graders, a 10-point difference. Conversely, 68 percent of 4th graders from lower-income backgrounds met basic standards compared with 50 percent of 8th graders in the same year, an 18-point difference.

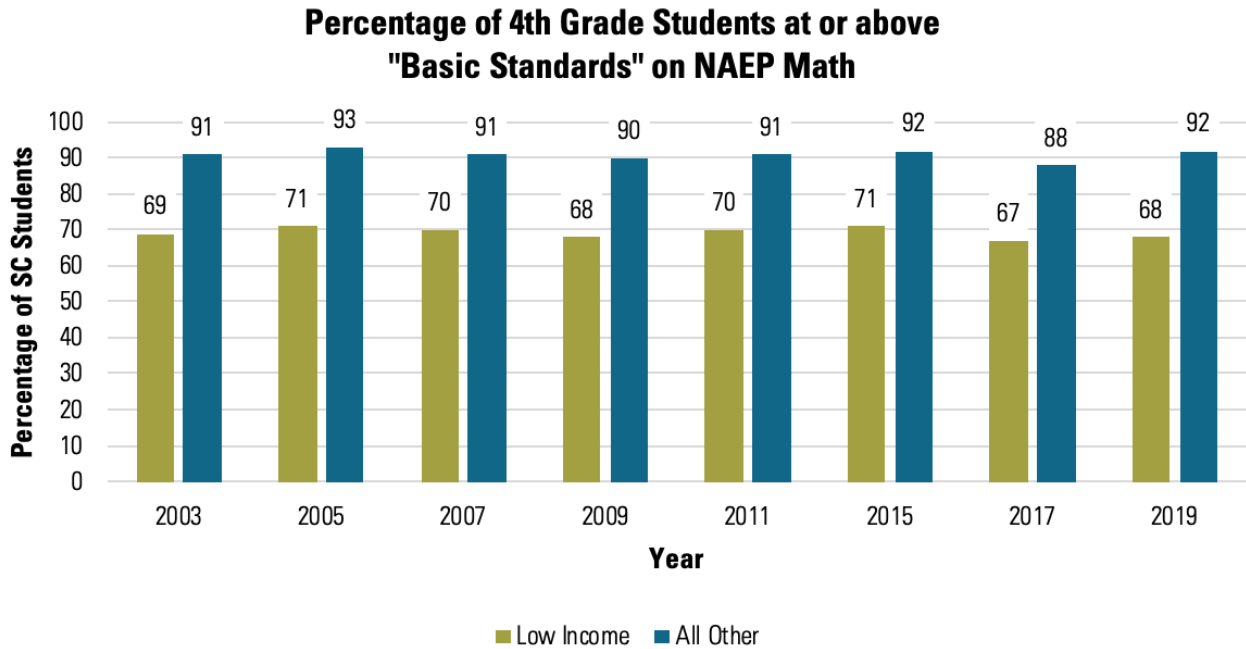
Figure 6. Comparison of achievement levels of 8th grade students in South Carolina on the National Assessment of Educational Progress on the mathematics section broken down by race.



Note: Data for Hispanic 8th grade students in 2003 was not available.

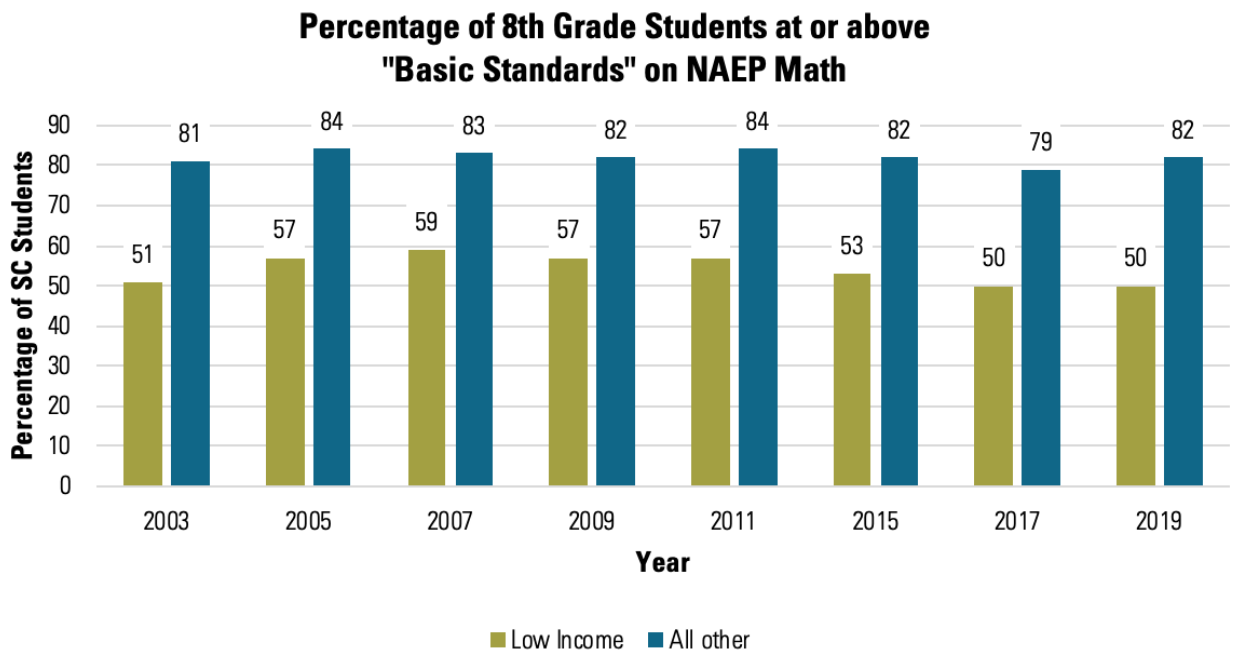
Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Figure 7. Comparison of achievement levels of 4th grade students in South Carolina on the National Assessment of Educational Progress on the mathematics section broken down by income.



Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

Figure 8. Comparison of achievement levels of 8th grade students in South Carolina on the National Assessment of Educational Progress on the mathematics section broken down by income.



Data Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP).

High School Math Readiness Indicators

Not only have test scores remained low for South Carolina students, but, also, within the last decade, multiple assessments have been used to measure college and career readiness among high school students in the state. From 2009-2014 South Carolina used the High School Assessment Program (HSAP), but the state then switched to using the ACT and ACT WorkKeys from 2015-2017. In 2018, the state then replaced these with Ready to Work, which measures career readiness using multiple scales, including knowledge of applied mathematics. The frequent changes in assessments have made it difficult to create a longitudinal snapshot of college and career readiness among high school students in the state. Below, we present the results from the HSAP, ACT WorkKeys, and Ready to Work as they are the most similar and represent the kind of math readiness that applies to both college and careers.

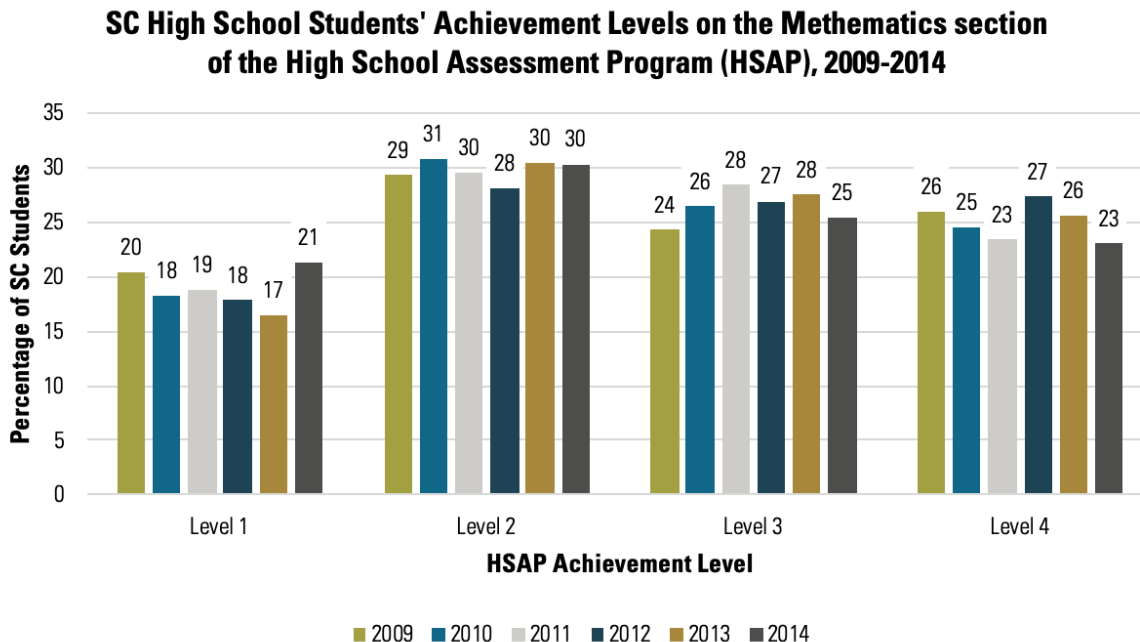
High School Assessment Program (HSAP)

During the six years that South Carolina used the High School Assessment Program to measure the overall achievement of high school graduates in the state, the achievement levels remained fairly stable with some minor fluctuations from one year to the next. In each year from 2013, 80 percent or more of high school graduates scored at level 2 or higher on the HSAP mathematics section; 2014 was the only year that dipped below that threshold when 79 percent of SC high school graduates met or exceeded level 2 proficiency in math.

ACT WorkKeys

In 2015, SC adopted ACT WorkKeys as a statewide assessment of career readiness. This assessment contained three tests, which included mathematics, locating information, and reading for information. Based on the level of achievement on these three tests, students could receive

Figure 9. Comparison of achievement levels of high school students in South Carolina on the High School Assessment Program between 2009 and 2014.



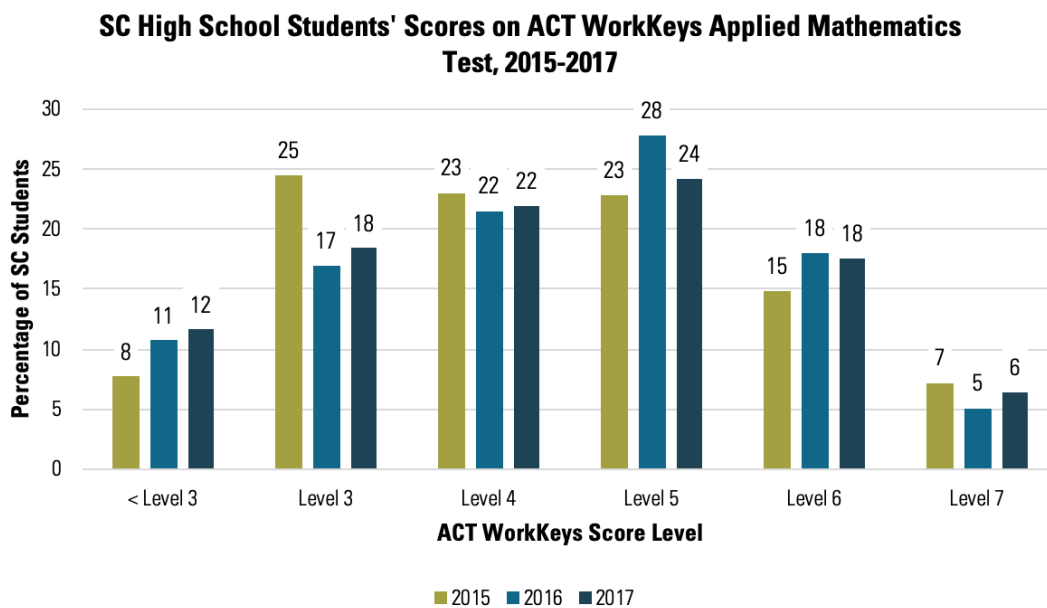
Data Source: SC Department of Education, Test Scores, <https://ed.sc.gov/data/test-scores/>

a “National Career Readiness Certificate” that would signal to employers that the students met a minimum level of proficiency and qualification for entry-level jobs in several fields. For example, the achievement of a Silver Certificate signifies that the holder meets basic qualifications for entry-level in 65% of occupations in the WorkKeys database. Earning a Silver Certificate requires a score of Level 4 on all three areas. Between 67 and 72 percent of high school students who took the ACT WorkKeys achieved

a Level 4 or higher in math between 2015 and 2017, which is the minimum math threshold for a Silver Certificate (Figure 10).

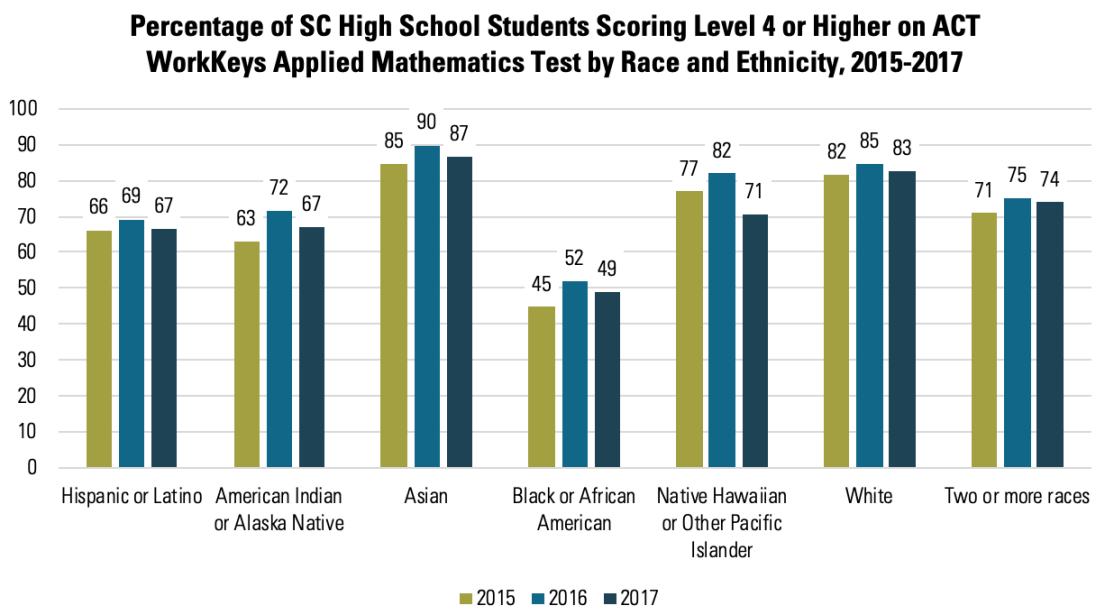
However, the same racial disparities that were revealed in the 4th and 8th grades through NAEP scores appear in the available data on ACT WorkKeys performance. Greater percentages of White and Asian students achieved Level 4 on the math tests than their Hispanic or Latino, American Indian or Alaska Native, or Black counterparts (Figure 11).

Figure 10. Comparison of achievement levels of high school students in South Carolina on the ACT WorkKeys Applied Mathematics test between 2015 and 2017.



Data Source: SC Department of Education, Test Scores, <https://ed.sc.gov/data/test-scores/>

Figure 11. Comparison of achievement levels of high school students in South Carolina on the ACT WorkKeys Applied Mathematics test between 2015 and 2017 by race and ethnicity.



Data Source: SC Department of Education, Test Scores, <https://ed.sc.gov/data/test-scores/>

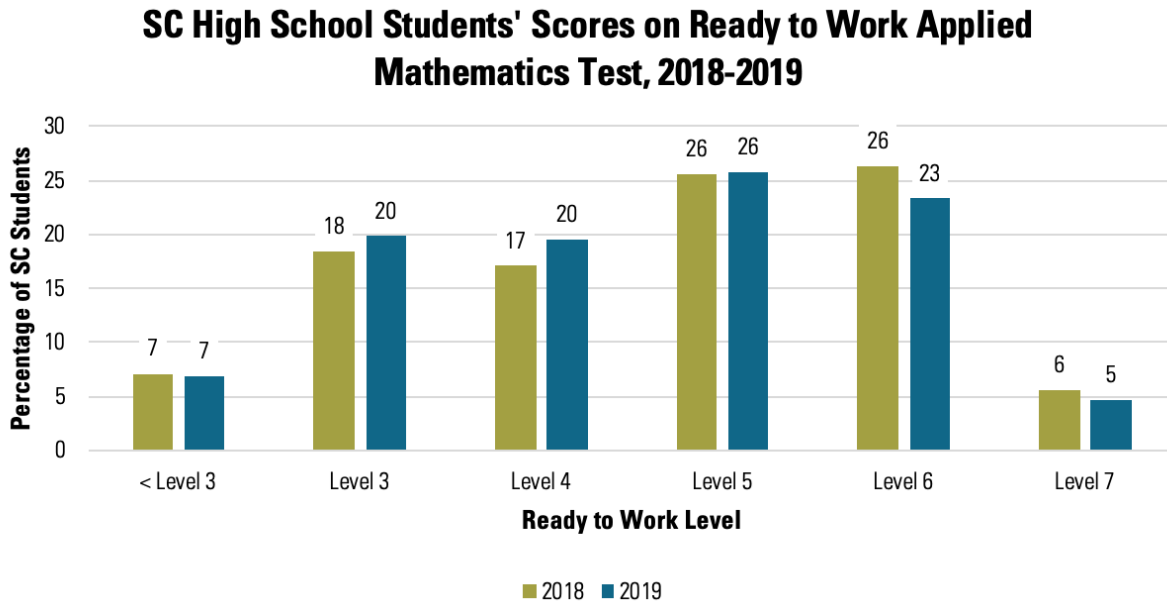
Ready to Work

In 2018, South Carolina adopted the Ready to Work readiness assessment for high school students. Its structure is nearly identical to ACT WorkKeys and also entitles students who achieve levels on all three tests to national readiness certificates. The distribution of student

scores on Ready to Work is not dissimilar to the previously used WorkKeys assessment (Figure 12).

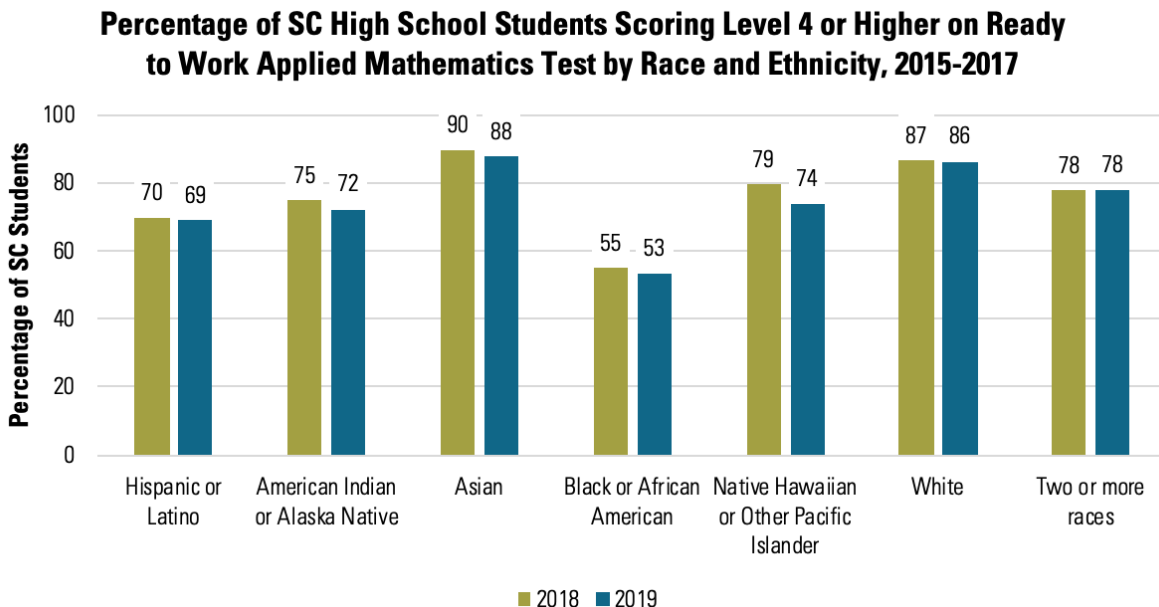
Again, the same racial disparities are evident in the Ready to Work assessment (Figure 13). More time will be necessary with the same instrument to identify if these achievement gaps will improve or persist in SC.

Figure 12. Comparison of achievement levels of high school students in South Carolina on the Ready to Work Applied Mathematics test between 2018 and 2019.



Data Source: SC Department of Education, Test Scores, <https://ed.sc.gov/data/test-scores/>

Figure 13. Comparison of achievement levels of high school students in South Carolina on the Ready to Work Applied Mathematics test between 2018 and 2019 by race and ethnicity.



Data Source: SC Department of Education, Test Scores, <https://ed.sc.gov/data/test-scores/>

What Do We Know About Math Readiness from These Indicators?

The indicators presented in this section indicate there is serious and significant work to be done to address the declining math performance among South Carolina students early in their educational trajectories. Historically, performance dropped for all students between the

4th and 8th grades. Moreover, gaps in math competence between racialized groups were apparent as early as the 4th grade and widened only four years later in the 8th grade. This disparity persisted through high school and has major implications for students' ability to graduate and succeed in their lives after graduation.

What is South Carolina Doing to Prepare Students to be Math Ready for College and Career?

Math preparation is of paramount concern because of its important roles in many fields of work, postsecondary pursuits of certificates and degrees, and military careers. The following sections describe efforts in South Carolina to support math preparation for students in secondary and postsecondary schools and careers. We also discuss math readiness concerns for educational professionals, administrators, and policy-makers with a specific focus on educator preparation in math.

Math Preparation in Secondary Schools

College and career preparation for South Carolina students begins in middle school. In sixth grade, students begin to work with guidance counselors to create an Individual Graduation Plan (IGP), which serves as a roadmap to students' intended academic and/or career goals beyond high school. IGP's require students to identify a chosen field of study from a selection of 15 career clusters. Students work with their counselors and parents and/or guardians to identify academic classes and out-of-class learning opportunities associated with their goals. IGP's are reviewed annually and are designed to be flexible to reflect students' evolving goals and interests (Southern Regional Education Board, n.d.).

In terms of math preparation, South Carolina high school students are required to complete four units of mathematics to earn a diploma. These courses include Foundations of Algebra or Algebra I and three additional math courses. For Algebra I/Math for the Technologies, students take an End-of-Course Examination, which is a standardized test that assesses their learning in the course. Further, students are required to take the ACT or SAT to

measure their readiness for college. Eligible students may enroll in advanced academic coursework, such as AP or IB courses, and/or participate in dual enrollment classes, in which they can earn college credit (Southern Regional Education Board, n.d.). Because Algebra I is the only math course assessed through an End-of-Course Examination, there may be gaps in SC's understanding of whether students are learning math content and if there are achievement gaps across students.

“Because Algebra I is the only math course assessed through an End-Of-Course Examination, there may be gaps in SC’s understanding of whether or not students are learning math content and if there are achievement gaps across students.”

Math Preparation for Career

Preparation to achieve proficiency in math is important for students who are eager to enter careers where they can develop and contribute skills and improve their earning potential. Below, we highlight two programs offered in South Carolina to assist with students' preparation in mathematics: Work-Based Learning and Military Career Pathways 101.

Work-Based Learning

South Carolina offers a range of work-based learning (WBL) programs to students that allow them to apply their mathematics learning toward a skill or trade relevant to their career interests. These opportunities offer structured learning experiences for students interested in entering a career directly after graduating from high school. WBL experiences involve various applied learning components, but each experience centers around cultivating relationships between students and industry (SC DOE, 2020g). Students and their career program sponsor complete a training agreement and evaluation plan that outlines skills that students will learn from their WBL experience. One prompt included in the plan requires students and employers to list three to five specific workplace and career skills students will acquire as a result of this experience. These skills are grouped into the following categories: career/engagement skills, digital literacy skills, applied academic skills, and STEM-related skills. Several of these skills require mathematics knowledge and competency, including coding, research and analysis, applied mathematics, and engineering and mathematics concepts, among others (SC DOE, 2020f).

Topics covered in Military Career Pathways 101 include:

- Utilizing career assessment tools
- Creating military-focused lesson
- Preparing students for STEM pathways in the military, among several other subjects

Work-Based Learning Options in South Carolina

SC currently offers 10 WBL options (Spearman, 2020):

1. Apprenticeship
2. Cooperative education (co-op)
3. Internship
4. Job shadowing (on-site)
5. Job shadowing (virtual)
6. Mentoring
7. School-based enterprise
8. Service learning
9. Structured field study
10. CTE internship, work-based credit bearing course

Military Career Pathways

Possessing a high school diploma or equivalent is required to join any branch of the military (Today's Military, 2020). In South Carolina, this means that each prospective military recruit needs to pass four math classes to enlist. To support students interested in joining the military, educators in South Carolina may enroll in Military Career Pathways 101, an institute sponsored by the Office of Career and Technology Education, SC Counseling Association, and military representatives in the state. The course is designed to provide information to educators about how they may counsel students about careers in the military (SC DOE, 2020b).

Math Preparation for Postsecondary Institutions

Math preparation is particularly important for students in South Carolina who intend to enroll in postsecondary programs in the state. There are several policies and practices within colleges and universities that are important for students, educators, and administrators to understand, as they can impact a student's ability to enter into and succeed within these institutions.

Four-Year Institutions

Each four-year college and university in South Carolina establish standards for undergraduate admission, and the South Carolina Commission on Higher Education reviews minimum admission policies and standards. The state's minimum math curriculum requirements for prospective undergraduate students include four units of math from Algebra I, Geometry, Algebra II, and a fourth unit (from Trigonometry, Pre-Calculus, Calculus, Statistics, Discrete Math, or another course). Prospective transfer students can use tools provided by SC TRAC (South Carolina Transfer and Articulation Center), including information about course and exam equivalencies and transfer agreements (South Carolina Transfer and Articulation Center, 2020).

Community/Technical Colleges

Prospective and admitted students in community and technical colleges in South Carolina are required to demonstrate college readiness through multiple means. First, to gain entry to many degree programs, prospective students must receive their high school diploma or GED. Additionally, students are required to demonstrate mathematics proficiency by completing entrance assessments, which may include ACT or SAT scores, placement test scores (such as COMPASS or ACCUPLACER exams). Students' scores on placement exams are used by advisors and other staff to place students into either college-level or developmental English and math courses. The South Carolina Commission on Higher Education mandated that developmental education only be offered at community and technical colleges in the state. Two-year schools in the University of South Carolina system, or those in the Palmetto College, do not offer any developmental coursework; instead, "enriched" sections of entry-level

courses are available, with the intent of preparing students for additional college-level coursework.

While the South Carolina Commission on Higher Education encourages two-year institutions to use common assessment and placement policies, developmental education policies differ by community and technical college. Per state policy, each college determines its minimal placement criteria (Education Commission of the States, 2018; South Carolina Commission on Higher Education, 1995). Inconsistencies could create potential problems for course alignment between these institutions and four-year schools and, also, increase the likelihood of credit loss and inapplicability for students upon transfer.

“Nationally, between 2003-2009, 59.3% of all students starting at a community college and 32.6% of those starting at a four-year school completed a developmental education course in math.”

Developmental Education

Many students are deemed academically underprepared for college-level coursework, notably in math, by postsecondary institutions. For instance, in 2010, a mere 43% of students across the nation were considered college ready in math by the ACT (Alliance for Excellent Education, 2011). Academically underprepared students are often required by their institutions to complete some form of remedial coursework upon entering college. Nationally, between 2003-2009, 59.3% of all students starting at a community college, and 32.6% of those starting at a four-year school, completed a developmental education course in math (Chen & Simone, 2016). Because of the large proportion of underprepared students, developmental education is widespread and is offered at institutions in nearly every state across the country (Boylan & Bonham, 2007).

Developmental education can be detrimental to students' academic achievement and persistence, and this is particularly pronounced among racial/ethnically minoritized students. For instance, results from national-level survey data show that from 2003-2009, 74.9% of Hispanic and 78.3% of Black students enrolled at community colleges took developmental courses in any

field (including math and English). Course-taking rates are higher than those of peers who identified as White (63.6%), Asian (68.1%), and other races (71.4%). Further, Black community college students took an average of 3.5 developmental courses, and Hispanic students took 4.0, which were greater than those that White students completed (2.4 courses) (Chen & Simone, 2016). Rates of student participation in developmental education at four-year institutions revealed even greater disparities than those seen at community colleges. Developmental education proves to be a significant structural barrier, as students placed into remedial sequences often demonstrate slower progress to degree completion and higher drop-out rates than their peers who were placed into college-level courses (Boatman & Long, 2010; Barry & Dannenberg, 2016). As such, multiple movements and reforms across the U.S. have aimed to restructure developmental education. A growing approach that states and systems have taken is the adoption of corequisite models, which have been associated with increased student pass rates through developmental education (Hern & Snell, 2014). Corequisite coursework allows students deemed academically underprepared to enroll in college-level, credit-bearing courses while receiving targeted institutional support in addition to these courses, notably in the form of a supplemental class or tutoring session or through technology-supported models (Hern & Snell, 2014).

In addition to corequisite approaches, various states have sought to align math courses and learning with students' intended majors and goals, ensuring that students have the necessary math skills to succeed both academically and in the workforce. These intentional approaches have been spearheaded by the Charles A. Dana Center's Mathematics Pathways, the Carnegie Foundation for the Advancement of Teaching's Carnegie Math Pathways, and the California Acceleration Project (Ganga & Mazzariello, 2018). Math pathways have been shown to decrease the time students spend in remedial coursework and increase success and persistence rates, particularly among minoritized student groups (Marshall & Fraga Leahy, 2019). Despite evidence of their success, institutions in South Carolina have not adopted math pathways nor has the state implemented coordinated corequisite approaches in postsecondary schools (Southern Regional Education Board, 2017).

“Math pathways have been shown to decrease the time students spend in remedial coursework and increase success and persistence rates, particularly among minoritized student groups.”

Concerns for Education Professionals, Administrators, and Policymakers

As important stakeholders in South Carolina continue to develop standards, understand indicators, and create programs to improve math readiness in the state, they must contend with structural and practical concerns that will moderate the achievement of math readiness objectives. We describe two concerns that educators, administrators, and policymakers must contend with related to math readiness: changing Algebra II and preparing and developing math educators in the state.

Changing Algebra II

Rapidly changing innovations both in career and college warrant math reforms that will provide students with relevant knowledge and skills needed to be successful (Charles A. Dana Center at The University of Texas at Austin, 2020). A significant curricular change involves reforming Algebra II courses in secondary schools. Currently, completion of Algebra II is an admissions requirement for many postsecondary institutions in South Carolina. Yet, Algebra courses may be irrelevant to students' academic plans, as several non-STEM-related degrees and career fields may not require students to learn or use such mathematics skills. Further, despite requests by colleges and universities for students to complete Algebra coursework, research shows that students may still be successful in college even if they do not take these courses (Charles A. Dana Center at The University of Texas at Austin, 2020). These findings prompt questions that consider the relevancy of students' math coursework to their college and career path of choice.

In addition to relevancy, mathematics coursework and course-taking also raise implications for equity. Due to variations in school curricula and instruction, students from higher-SES families tend to have access to higher-quality programs and advanced courses, such as Calculus (Charles A. Dana Center at The University of Texas at Austin, 2020). Thus, racially/ethnically minoritized students and those from low SES families may be considered underprepared in mathematics by their schools. This may have severe implications for students' postsecondary progress, as research has identified that students may associate academic unpreparedness with an inability to succeed in college and/or the workplace.

Currently, South Carolina has not issued any publicly available plans for addressing Algebra reforms in the state. Yet, if the state aspires to promote mathematics success for all students, additional examinations into the relevancy of math courses to students' intended college and career plans may be needed.

Recommendations to better prepare for postsecondary education or the workforce include (Kirst, 2013):

- Amending graduation plans that require high school students to take Algebra II, making it instead optional
- Allowing students more time and opportunities for deeper learning in order to master pre-Algebra coursework, which will prepare them for success in future mathematics courses.

Educator Preparation and Development

To develop educator preparation standards, the South Carolina Department of Education (SCDE) and the State Board of Education (SBE) draw upon standards developed by the Council for the Accreditation of Educator Preparation (CAEP) as well as other practices and policies. The SCDE requires that all state-accredited educator preparation programs meet CAEP standards, and all programs related to PK–12 preparation must meet the requirements of CAEP, another nationally recognized accrediting agency, or the program-level standards established by the SBE (SC DOE, 2020d).

To become an educator in South Carolina, teachers must possess a teaching license, which is typically earned through a bachelor's degree-granting teacher preparation program at a postsecondary institution. These programs traditionally require students to complete a series of core curriculum courses, which serve as a foundation for students' areas of study; as part of the core, students are usually required to complete a math or quantitative literacy requirement. Students seeking to teach at the secondary level (i.e., in middle and/or high schools) are required to take more advanced courses in the subject in which they intend to teach (Southern Regional Education Board, 2018; SC DOE, 2020c).

Prospective educators seeking admission into undergraduate degree programs in teaching must pass all sections of the Praxis Core Academic Skills for Educators

assessments in reading and mathematics. Educators are also required to take Praxis II Subject Tests, which assess their pedagogical and subject content knowledge; approved assessments include edTPA, Principles of Learning and Teaching, and Praxis Performance Assessment for Teachers. Educators must also engage in clinical experience to gain licensure for 12 weeks or 60 days (Southern Regional Education Board, 2018; SC DOE, 2020a). Considering the crucial role that educator preparation programs play in teachers' development as educators, it is important to examine the curricula, objectives, and competencies presented to teachers. Further questions for consideration include: Do educator preparation programs include racial- and equity-minded approaches and content? Are teachers made aware of structural inequities, discriminatory practices, and deficit-minded frameworks that may exist in policy and practice? Further, are teachers allowed opportunities to reflect on these issues and, most importantly, to make changes to ensure success for all students?

What South Carolina is Doing to Prepare Students for Math Readiness

South Carolina must consider a full spectrum of approaches to support the math preparation of students and to create opportunities for success through and after K-12 education. Both teacher preparation and ensuring that educational environments are well structured and supported through improvements in secondary math curriculum and postsecondary policies are key in achieving math readiness objectives for the state. However, without a deep commitment to the ongoing improvement of the full range of initiatives and programs aimed at supporting student success in the state, the promise of these programs will be impaired.

“Do educator preparation programs include racial- and equity-minded approaches and content? Are teachers made aware of structural inequities, discriminatory practices, and deficit-minded frameworks that may exist in policy and practice?”

What Have We Learned about Math Readiness in South Carolina?

Math readiness in South Carolina presents a complex and interconnected ecosystem of definitions, indicators, policies, and practices. In this section, we present a discussion of two emergent perspectives that resulted from our review of the materials: policies and their effects and racial inequities. We conclude the report by offering potential research questions whose answers we believe will contribute to progress in math readiness in South Carolina.

Policies and Effects

Our review of math readiness in South Carolina reveals something of a paradox: it is first apparent that key stakeholders in the state, including legislators, policymakers, educational leaders, and members of groups interested in improving the business and industry in South Carolina recognize the importance of the development of math competencies. There have been several efforts cited throughout this report and elsewhere (see EPIC, 2015; Hoffman et al., 2018; Petcu et al., 2016; Young et al., 2019) aimed at improving students' readiness for college and careers with a particular emphasis on math. However, it is clear from a review of the materials collected that guidelines have shifted rapidly over the past several years. Despite these innovations, it is unreasonable to believe that new policies would have an immediate effect on outcomes or to correct issues that have persisted for many years.

Notwithstanding, our review points to several implications for this shifting landscape. First, South Carolina could benefit from a concise and clear structure for how math, college, and career readiness efforts work together. One possible approach is to combine definitions of readiness, indicators, and resulting policies (e.g., math standards, graduation requirements, the articulation between secondary and post-secondary institutions, and teacher training) into a framework that articulates how these parts work together and offer practical recommendations for math education (as well as other key and critical subject areas, such as ELA and social sciences). We believe this could result in a more actionable and practical definition of math readiness. While the *Profile of the SC Graduate* has provided a common language and vision for multiple groups in the state around the importance of

college and career readiness, ultimately, it is aspirational and does not enumerate achievable goals or point to guideposts for how the state will achieve its objectives for college and career readiness, generally, or math readiness, specifically.

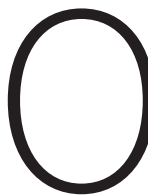
Racial Inequities

South Carolina has made many efforts to address the fact that the state is falling behind in math preparation and is losing ground relative to the national average. An alarming aspect of this reality is that the South Carolina education system has and continues to privilege White students over other races and ethnicities; this evidence is notable as White students continue to achieve at higher levels and rates than minoritized students. Gaps in math competence between racialized groups are apparent as early as the 4th grade and widen only four years later in the 8th grade. This disparity persists through high school and, therefore, into students' abilities to achieve their educational and vocational goals.

The easy response to such observations is that disparity is widely documented and well known. Yet, the state's policies, programs, and practices all fail to address these pervasive and persistent problems with any racial equity framework. If gaps in math achievement are already common knowledge, the lack of an equity-focused response is akin to pointing to a row of homes on fire without calling for a fire brigade. Moreover, because many of the people who gather, report, and interpret the data are also in control of the standards, resources, and personnel required to do something about the disparities, the more appropriate analogy may be pointing to the blaze without getting into the firetruck and attempting to extinguish the flames. Unless all actors in South Carolina

immediately begin to openly and honestly discuss persistent performance gaps among students, the state will continue to perpetuate systematic segregation of and discrimination against schools, colleges, workplaces, and communities. There is work that must be done to redress this critical aspect of math readiness, and any approach to improve math achievement without specific and targeted plans for improving success among minoritized students is incomplete and a conscious decision to maintain systemic inequality.

Future Research



Our review of the state of math readiness in South Carolina indicates multiple areas for further investigation. Below, we present several prominent questions that we believe the answers to, will provide educators, leaders, and policymakers in the state with information that will lead to improved math readiness in South Carolina.

Math Readiness in South Carolina Research Questions

Policies

- How are state and local policies related to math readiness for college and career connected to state and local outcomes?
- How can SC create math pathways that are equitable and designed to reach students' academic and career goals?
- How are school and district level resources associated with student performance outcomes in math?
- When student outcomes are disaggregated by race, gender, and income, how does this illuminate inequitable distribution of resources for minoritized students?

Administrator and Teacher Experiences

- How do district and school-level administrators interpret and implement policies and standards associated with math readiness?
- How do teachers and other educators interpret and implement policies and standards associated with math readiness?
- In what ways do biases (both implicit and explicit) manifest in educators' and policymakers' practices?
- What barriers do teachers and administrators face as they implement math policies and standards?
- What equity-minded training and/or professional development opportunities are available for educators across the state?
- How can educators have discussions about and hold themselves accountable for working to solve issues associated with disparities in student outcomes, discrimination, prejudice, and more?

Student Experiences

- What are students' experiences in SC's changing policy environment, and what role does this play in their math achievement?
- What are SC students' experiences in math during 4th to 8th grade, a period during which many students' performance declines?
- What role do schools play in supporting the holistic needs of students?
- What diagnostic tools are available to identify and respond to students' math progress?
- What forms of classroom pedagogy and assessment benefit and empower students, particularly those in racialized groups?

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