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Math course sequences in grades 6–11 and math achievement in Mississippi

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Fewer than one in five grade 11 students in Mississippi is ready for college math, even though state high school graduation requirements include Algebra I and three additional math credits. Because the requirements do not specify what math courses must be taken to fulfill the additional three credits, students generally select from a list of approved courses, which raises the need to understand the extent to which math course sequences are related to college ready performance on the ACT. This study examined the sequences of math courses that Mississippi students who started grade 6 in 2011/12 took in grades 6–11; the math achievement and demographic characteristics of students who took similar math sequences; and how math sequences, prior math achievement, and student demographic characteristics relate to college readiness in math. Math sequences became more diverse in later grades, consistent with the increase in course options. Students took 3,404 unique math sequences, which can be grouped into six clusters based on similarities in the courses taken and the order in which they were taken. Average math achievement in grade 11 was highest for students who followed the Algebra I to Geometry to Algebra II to Algebra III sequence beginning in grade 8; the sequence was followed by disproportionately more female students than male students and more White students than Black students. Grade 5 math achievement and race/ethnicity—but not math sequence—were the most efficient variables with the highest classification accuracy for identifying a student as at risk of failing to meet the ACT college readiness benchmark in math. This suggests that there is no clear relationship between math sequence and the likelihood of being ready for college math, after grade 5 math achievement and race/ethnicity are controlled for.

Why this study?

Fewer than one in five grade 11 students in Mississippi is ready for college math based on the state's 2017/18 ACT math scores (Mississippi Department of Education, 2018). Nearly identical results were found in 2014/15 when Mississippi began testing the college readiness of all grade 11 public high school students. At that time the average ACT math score was 17.6, and approximately 18 percent of students met the college readiness benchmark score of 22. This problem is not limited to Mississippi, as evidenced by newly released ACT math scores for all U.S. high school graduates showing that college readiness in math has steadily declined since 2014, with only 40 percent of 2018 ACT-tested high school graduates meeting the ACT college readiness benchmark in math (ACT, 2018).

Only a small percentage of Mississippi students are ready for college math even though state high school graduation requirements include Algebra I and three additional math credits as well as updated academic standards. In the 2014/15 school year Mississippi adopted new academic standards and modified subject-specific courses, such as Algebra I, Geometry, and Algebra II, to align to the new standards (Mississippi Department of Education, 2014). In addition,

For additional information on the study's methods, access the report appendix at https://go.usa.gov/xyfzC.

Mississippi developed new integrated math courses combining algebra with relevant material in geometry, trigonometry, and statistics,[1] as well as new compacted courses covering two years of math content in one academic year for middle school students who qualify, thus enabling students to take college-level math courses by grade 12. Recommended course sequences were developed to align the state's math courses to the suggested pathways in the Common Core State Standards for Mathematics (Common Core State Standards Initiative, 2010).

One variable that may be associated with college-ready performance on the ACT in Mississippi is the course sequence that students follow to complete the graduation requirement in math. Beyond Algebra I, the state allows flexibility in how students complete their math credits within a list of approved courses. As such, students can begin algebra coursework in middle school or high school and can complete math courses in different orders, depending on what their school offers and their readiness to begin algebra before high school. High school students can also take accelerated coursework such as Advanced Placement or postsecondary dual enrollment courses.[2]

This study examined the sequences of math courses that Mississippi students took in grades 6–11; the math achievement and demographic characteristics of students who took similar math sequences; and how math sequences, math achievement prior to grade 6 (measured at the end of elementary school in grade 5), and student demographic characteristics relate to college readiness in math. Understanding these associations may highlight potential areas of future study on math achievement gaps in the state. In addition, the results may inform professional learning opportunities to help teachers identify students who require additional support, ultimately minimizing these gaps and increasing overall ACT math performance.

Research questions

This study analyzes the extent to which math course sequences are related to college-ready performance on the ACT. Three research questions related to math sequences in grades 6–11 among Mississippi students who started grade 6 in 2011/12 guide the analyses:

1. What math sequences did students take?

2. How do math achievement and demographic characteristics differ across math sequences?

3. Does a student's math sequence predict college readiness in math?

The analysis for research question 1 identified the most common math sequences and grouped similar sequences into clusters to facilitate further analysis. The analyses for research questions 2 and 3 explored differences in math achievement and demographic characteristics across those clusters to determine whether college-ready performance in math on the ACT is associated with specific math sequences or other factors.

Key terms used in this report are defined in box 1. The data sources, sample, and methods are summarized in box 2 and discussed in detail in appendix A.

1. These courses were discontinued in the 2017/18 school year.
2. See Mississippi Department of Education (2015) for a list of all courses eligible for student enrollment in Mississippi public schools, including the number of credits to be earned and whether the course meets high school graduation requirements.

Box 1. Key terms used in this report

College-ready performance in math. Performance at or above the college readiness benchmark score of 22 in math on the ACT (Allen & Radunzel, 2017). ACT math performance is used as a proxy for college readiness because of the complexity of identifying all the factors that determine whether a student is truly ready for success in college.

Combinations of math courses. Two or more statewide courses taken in the same year.

Math sequence. The order in which a student takes a series of math courses.

Statewide course. A course on the approved list published annually by the Mississippi Department of Education (Mississippi Department of Education, 2015).

Student math achievement and demographic characteristics. Student math score on the Mississippi Curriculum Test, Second Edition, in grade 5, ACT math score in grade 11, gender, race/ethnicity, and eligibility for the national school lunch program (a proxy for economic disadvantage).

Box 2. Data sources, sample, and methods

Data sources. The study used longitudinal student-level transcript data, student achievement data, and student demographic data for 2011/12–2016/17 obtained through a data-sharing agreement between the Regional Educational Laboratory Southeast and the Mississippi Department of Education.

Sample. The study sample included all students enrolled in grade 11 in a Mississippi public high school during the 2016/17 school year who had an ACT math score from February or March 2017 and recorded coursework in grade 6. Data were available for 27,680 of the 32,837 eligible students in grade 11; 2,259 students were missing ACT math scores in grade 11, and 2,898 students were missing a record of coursework in grade 6.

Methods. To understand Mississippi students' math sequences (research question 1), the study used sequence analysis, a method for uncovering unique sequences within data that is typically used to describe and visualize sequences of events. In this study sequence analysis was used to describe the coursework that each student took each year in grades 6–11. Student course records were coded using state-approved course numbers for single courses and study team–created course numbers for combinations of two or more statewide courses taken in the same year, so that each student had only one course code per year (a requirement for the sequence analysis). The statistical package *TraMineR* (Gabadinho, Ritschard, Müller, & Studer, 2011) was used to conduct the sequence analysis. The sequences were then grouped into clusters of similar sequences for descriptive purposes using the statistical package *cluster* (Maechler, Rousseeuw, Struyf, Hubert, & Hornik, 2018). Measures of cluster quality, including visual inspection and statistical indices, were used to select the number of clusters.

To describe differences in average student achievement on statewide assessments and student demographic characteristics (gender, race/ethnicity, and eligibility for the national school lunch program) by sequence cluster (research question 2), the study examined means and standard deviations. Because over 90 percent of the Mississippi student population is either White or Black, the presentation of race/ethnicity data was limited to these two groups.

Finally, to predict college readiness in math in grade 11 (research question 3), the study used grade 5 math achievement, demographic characteristics, and math sequence clusters in a classification and regression tree (CART) model. About 19 percent of grade 11 students in the sample met the benchmark. The dataset was split into a calibration dataset (used to build the CART models) consisting of a random sample of 80 percent of the students and a validation dataset (used to test the CART models) consisting of the remaining 20 percent. Several traditional indexes of classification accuracy were used to evaluate results from the prediction model (Schatschneider, Petscher, & Williams, 2008). The statistical package *rpart* (Therneau & Atkinson, 2018) was used for the CART analysis.

Findings

This section first highlights the most common math sequences that students took in grades 6–8, grades 9–11, and grades 6–11 combined. It then groups the sequences for grades 6–11 into six clusters and provides average student achievement and demographic characteristics for each cluster. Finally, it presents key findings of the relationship between math sequence and college-ready performance on the ACT.

Math sequences became more diverse in later grades, consistent with the increase in course options

As students progressed from middle school to high school, additional course options became available, including accelerated coursework (such as dual enrollment and Advanced Placement courses) and remedial coursework. This led to more diversity in math sequences. For example, there were 11 statewide courses in grade 6, which rose to 36 in grade 11 (table 1). The number of combinations of courses also increased with the number of available statewide courses. Many of the most common combinations included a compensatory math course, which may be eligible for elective credit, paired with a math credit-bearing course.

Table 1. Number of Mississippi statewide courses and combinations of courses, by grade, 2011/12–2016/17

Grade	Statewide courses	Combinations of courses[a]	Total
6	11	16	27
7	16	35	51
8	21	55	76
9	26	83	109
10	30	83	113
11	36	136	172

Note: Courses may have been offered in more than one grade; there were 106 unique statewide courses and combinations of courses in grades 6–8 and 286 in grades 9–11.

a. Combinations of courses reflect instances of students taking two or more statewide courses in the same year. The most common combinations were Math (grades K–6) and Compensatory Math in grade 6, Math (grade 7) and Compensatory Math in grade 7, Pre-Algebra and Compensatory Math in grade 8, Algebra I and Compensatory Math I in grade 9, and Geometry and Algebra II in grades 10 and 11.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Math sequences were examined for three groupings: grades 6–8 (middle school), grades 9–11 (high school), and grades 6–11 (secondary school).

Grades 6–8. Some 84 percent of students followed one of the 10 most common of the 498 sequences in grades 6–8 (table 2). About 51 percent of students followed the most common sequence: Math (grades K–6) to Math (grade 7) to Pre-Algebra. The second most common sequence is a more advanced sequence: Math (grades K–6) to Pre-Algebra[3] to Algebra I.

3. Pre-Algebra served as a bridge between math in lower grades and Algebra I and was designed to prepare students for Transition To Algebra or Algebra I. Transition To Algebra served as an additional opportunity for students to develop the foundational math skills required to be successful in Algebra I and is found in the third and fourth most common sequences. Both Pre-Algebra and Transition To Algebra were removed from the approved course list at the beginning of the 2014/15 school year.

Table 2. The 10 most common math sequences in grades 6–8 in Mississippi, 2011/12–2013/14

Sequence	Grade 6	Grade 7	Grade 8	Number of students	Percentage of students
1	Math (grades K–6)	Math (grade 7)	Pre-Algebra	14,172	51.2
2	Math (grades K–6)	Pre-Algebra	Algebra I	2,760	10.0
3	Math (grades K–6)	Pre-Algebra	Transition To Algebra	1,831	6.6
4	Math (grades K–6)	Math (grade 7)	Transition To Algebra	1,149	4.2
5	Math (grades K–6)	Math (grade 7)	Algebra I	1,133	4.1
6	Math (grades K–6)	Math (grade 7)/Compensatory Math	Pre-Algebra	609	2.2
7	Math (grades K–6)/ Compensatory Math	Math (grade 7)	Pre-Algebra	488	1.8
8	Math (grades K–6)	Pre-Algebra	Pre-Algebra	450	1.6
9	Math (grades K–6)	Math (grade 7)	Pre-Algebra/Compensatory Math	346	1.2
10	Math (grades K–6)/Math–Remedial	Math (grade 7)	Pre-Algebra	304	1.1
			Total	23,242	84.0

Note: Numbers in parentheses refer to the grade level of the course. Compensatory Math is eligible for secondary school credit; Math—Remedial is not eligible for secondary school credit and is available only to students in grades 1–6. The total number of sequences in grades 6–8 was 498.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Grades 9–11. Some 66 percent of students followed one of the 10 most common of the 1,375 sequences in grades 9–11 (table 3), a smaller percentage than at the middle school level. About 24 percent of students followed the most common sequence: Algebra I to Geometry to Algebra II. About 22 percent followed the second most common sequence: Algebra I and Compensatory Math I to Geometry to Algebra II. And about 10 percent followed the third most common sequence: Geometry to Algebra II to Algebra III,[4] a more advanced sequence that is likely an extension of sequences that ended with Algebra I in grade 8.

Table 3. The 10 most common math sequences in grades 9–11 in Mississippi, 2014/15–2016/17

Sequence	Grade 9	Grade 10	Grade 11	Number of students	Percentage of students
1	Algebra I	Geometry	Algebra II	6,585	23.8
2	Algebra I/Compensatory Math I	Geometry	Algebra II	6,061	21.9
3	Geometry	Algebra II	Algebra III	2,643	9.6
4	Algebra I/Compensatory Math I	Algebra II	Geometry	589	2.1
5	Geometry	Algebra II	Advanced Math Plus	498	1.8
6	Algebra I	Algebra II	Geometry	440	1.6
7	Algebra II	Geometry	Algebra III	387	1.4
8	Transition To Algebra/ Compensatory Math I/Algebra I	Geometry	Algebra II	350	1.3
9	Algebra I/Compensatory Math I	Algebra I	Geometry	326	1.2
10	Algebra I	Geometry/Algebra II	Algebra III	247	0.9
			Total	18,126	65.5

Note: The total number of sequences in grades 9–11 was 1,375.

Source: Authors' analysis based on data from the Mississippi Department of Education.

4. Algebra III was previously called Pre-Calculus.

Grades 6–11. Some 47 percent of students followed one of the 10 most common of the 3,404 sequences in grades 6–11 (table 4), an indication that math sequences became more diverse in later grades. About 16 percent of students followed the most common sequence, and 14 percent followed the second most common sequence; the sequences differ only in grade 9, where students in the most common sequence took Algebra I and students in the second most common sequence took both Algebra I and Compensatory Math I. Both sequences end in Algebra II. The third and fourth most common sequences both end in Algebra III and differ only by whether the student took Pre-Algebra or Math in grade 7.

Table 4. The 10 most common math sequences in grades 6–11 in Mississippi, 2011/12–2016/17

Sequence	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Number of students	Percentage of students
1	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I	Geometry	Algebra II	4,278	15.5
2	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	3,837	13.9
3	Math (grades K–6)	Pre-Algebra	Algebra I	Geometry	Algebra II	Algebra III	1,341	4.8
4	Math (grades K–6)	Math (grade 7)	Algebra I	Geometry	Algebra II	Algebra III	672	2.4
5	Math (grades K–6)	Pre-Algebra	Transition To Algebra	Algebra I	Geometry	Algebra II	664	2.4
6	Math (grades K–6)	Pre-Algebra	Transition To Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	486	1.8
7	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I/ Compensatory Math I	Algebra II	Geometry	485	1.8
8	Math (grades K–6)	Math (grade 7)	Transition To Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	442	1.6
9	Math (grades K–6)	Pre-Algebra	Algebra I	Geometry	Algebra II	Advanced Math Plus	338	1.2
10	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I	Algebra II	Geometry	325	1.2
					Total		12,868	46.6

Note: Numbers in parentheses refer to the grade level of the course. The total number of sequences in grades 6–11 was 3,404.

Source: Authors' analysis based on data from the Mississippi Department of Education.

The 3,404 unique math sequences that students took in grades 6–11 can be grouped into six clusters based on similarities in the courses taken and when they were taken

Math sequences differ according to differences in the courses taken and in the grades when they were taken. For example, the two most common sequences in grades 6–11 differ only by the course taken in grade 9 (see table 4). Cluster analysis was used to group the 3,404 unique sequences into six clusters (table 5). Each cluster is referred to by a letter and a short name based on its distinguishing features (generally the most common sequences).

Table 5. The six math sequence clusters for the 3,404 math sequences in grades 6–11 in Mississippi, 2011/12–2016/17

Cluster	Number of students	Percentage of students
A. Pre-Algebra in grade 8 to a combination of courses that includes Algebra I in grade 9	6,437	23.3
B. Transition To Algebra in grade 8 without prior Pre-Algebra	5,772	20.9
C. Pre-Algebra in grade 8 to Algebra I in grade 9	5,533	20.0
D. Algebra I in grade 8	4,265	15.4
E. Pre-Algebra in grade 8 to the combination of Algebra I and Compensatory Math I in grade 9	3,837	13.9
F. Pre-Algebra in grade 7 to Transition To Algebra in grade 8	1,836	6.6

Note: Percentages do not sum to 100 because of rounding.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Some clusters are more uniform than others. A cluster's uniformity can be evaluated based on the percentage of students in the cluster who followed the two most common sequences. For example, the two most common sequences in cluster B were followed by 7.7 percent and 5.4 percent of the students in the cluster, respectively, while cluster E has only one sequence, which was followed by 100 percent of the students in the cluster (table 6). This means that cluster B is less uniform than cluster E and that within cluster B there are more differences in courses taken, the grade in which courses were taken, or both.

Table 6. The most common math sequences in grades 6–11 in Mississippi, by sequence cluster 2011/12–2016/17

Cluster	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Number of students	Percentage of students
A	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I/ Compensatory Math I	Algebra II	Geometry	485	7.5
	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Transition To Algebra/ Compensatory Math I/Algebra I	Geometry	Algebra II	296	4.6
B	Math (grades K–6)	Math (grade 7)	Transition To Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	442	7.7
	Math (grades K–6)	Math (grade 7)	Transition To Algebra	Algebra I	Geometry	Algebra II	309	5.4
C	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I	Geometry	Algebra II	4,278	77.3
	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I	Algebra II	Geometry	325	5.9
D	Math (grades K–6)	Pre-Algebra	Algebra I	Geometry	Algebra II	Algebra III	1,341	31.4
	Math (grades K–6)	Math (grade 7)	Algebra I	Geometry	Algebra II	Algebra III	672	15.8
E	Math (grades K–6)	Math (grade 7)	Pre-Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	3,837	100.0
F	Math (grades K–6)	Pre-Algebra	Transition To Algebra	Algebra I	Geometry	Algebra II	664	36.2
	Math (grades K–6)	Pre-Algebra	Transition To Algebra	Algebra I/ Compensatory Math I	Geometry	Algebra II	486	26.5

Note: Numbers in parentheses refer to the grade level of the course. Cluster E has only one sequence.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Cluster A. Pre-Algebra in grade 8 to a combination of courses that includes Algebra I in grade 9. This cluster's sequences were followed by 23 percent of students. It has a diverse set of sequences. The two most common sequences were followed by 8 percent and 5 percent of the students in the cluster, respectively, and show that the cluster is distinguished from the other clusters by students taking Pre-Algebra in grade 8 and the combination of Algebra I or Transition To Algebra and Compensatory Math I in grade 9.

Cluster B. Transition To Algebra in grade 8 without prior Pre-Algebra. This cluster's sequences were followed by 21 percent of students. Like cluster A, this cluster has many distinct sequences. The two most common sequences were followed by 8 percent and 5 percent of the students in the cluster, respectively, and show that the cluster is distinguished from the other clusters by students taking Math in grade 7 and Transition To Algebra in grade 8.

Cluster C. Pre-Algebra in grade 8 to Algebra I in grade 9. This cluster's sequences were followed by 20 percent of students. The two most common sequences were followed by 77 percent and 6 percent of the students in the cluster, respectively, with most students taking Math in grade 7, Pre-Algebra in grade 8, Algebra I in grade 9, and either Geometry or Algebra II in grade 10.

Cluster D. Algebra I in grade 8. This cluster's sequences were followed by 15 percent of students. The two most common sequences were followed by 31 percent and 16 percent of the students in the cluster, respectively, and include Algebra I in grade 8 and Algebra III in grade 11. The two sequences differ only by whether the student took Pre-Algebra or Math in grade 7. This cluster consists of the most rigorous sequence of courses among the six clusters.

Cluster E. Pre-Algebra in grade 8 to the combination of Algebra I and Compensatory Math I in grade 9. This cluster's sequences were followed by 14 percent of students. It has only one sequence, which was followed by all students in the cluster. All students took Pre-Algebra in grade 8 and the combination of Algebra I and Compensatory Math I in grade 9.

Cluster F. Pre-Algebra in grade 7 to Transition To Algebra in grade 8. This cluster's sequences were followed by 7 percent of students. The two most common sequences were followed by 36 percent and 27 percent of the students in the cluster, respectively, and include Pre-Algebra in grade 7 and Transition To Algebra in grade 8.

Average math achievement in grade 11 was highest for students who followed the Algebra I to Geometry to Algebra II to Algebra III sequence beginning in grade 8; the sequence was followed by disproportionately more female students than male students and more White students than Black students

Average math achievement and demographic characteristics differed across clusters. Students in cluster D—which includes the most rigorous coursework, ending with Algebra III—had the highest average math score on the Mississippi Curriculum Test, Second Edition (MCT2), in grade 5 and the highest percentage of students meeting the ACT college readiness benchmark in grade 11 (table 7). Students in cluster E had the lowest average MCT2 math score in grade 5 and the lowest percentage of students meeting the ACT college readiness benchmark in grade 11. Cluster D, with the highest student achievement, was followed by disproportionately more female students than male students and more White students than Black students (figure 1). Cluster E, with the lowest student achievement, was followed by disproportionately more Black students than White students and more students eligible for the national school lunch program than students who were not eligible.

Table 7. Student math achievement by math sequence cluster for grades 6–11 in Mississippi, 2011/12–2016/17

Achievement measure	Cluster A	Cluster B	Cluster C	Cluster D	Cluster E	Cluster F	Full sample
Average MCT2 math score in grade 5	150.0 (10.6)	152.9 (12.6)	151.0 (9.9)	163.1 (8.6)	149.9 (9.0)	156.1 (10.0)	153.3
Average ACT math score in grade 11	16.8 (3.4)	17.9 (4.3)	16.8 (2.9)	21.4 (4.5)	16.5 (2.6)	19.1 (3.9)	17.8
Percentage meeting the ACT college readiness benchmark in math in grade 11	11.6	20.4	9.0	49.4	6.4	26.6	19.0

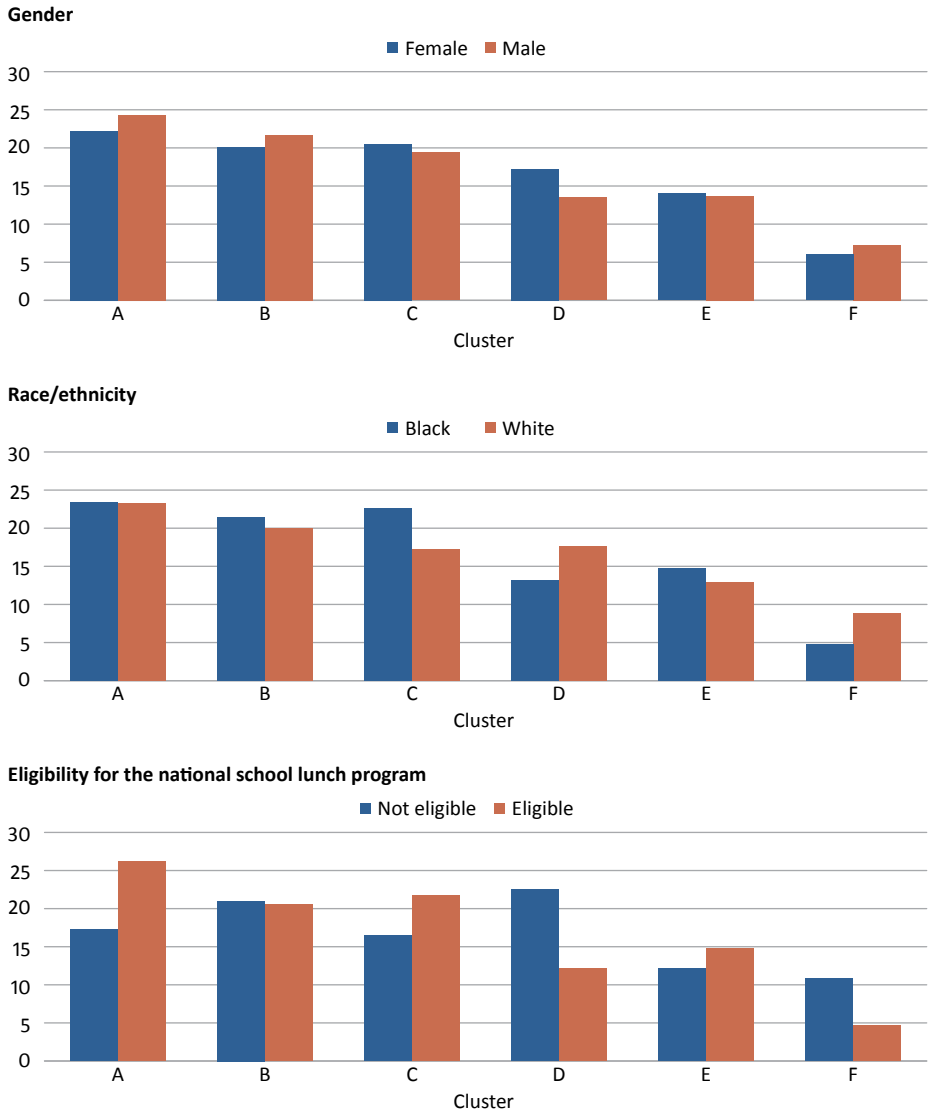
MCT2 is Mississippi Curriculum Test, Second Edition.

Note: See table 6 for a description of the clusters. Numbers in parentheses are standard deviations.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Figure 1. Cluster D, the math sequence cluster for grades 6–11 in Mississippi with the highest student achievement, was followed by disproportionately more female students than male students and more White students than Black students, 2011/12–2016/17

Percent



Note: See table 6 for a description of the clusters. Percentages within each comparison group sum to 100.

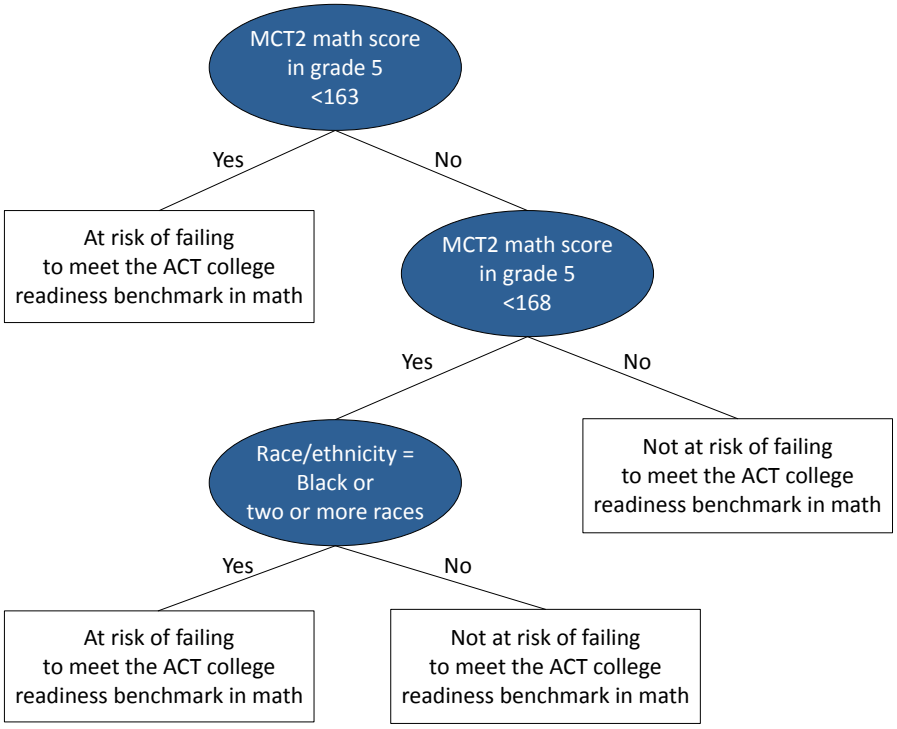
Source: Authors' analysis based on data from the Mississippi Department of Education.

Grade 5 math achievement and race/ethnicity—but not math sequence—were the most efficient variables with the highest classification accuracy for identifying a student as at risk of failing to meet the ACT college readiness benchmark in math

Going beyond average differences in achievement between clusters, the study examined whether math sequence cluster predicts college-ready performance. Five student-level variables were considered in the classification and regression tree (CART) model: gender, race/ethnicity, eligibility for the national school lunch program, grade 5 math achievement, and math sequence cluster membership. The model selected grade 5 math achievement and race/ethnicity as the most efficient variables with the highest classification accuracy. They predict college-ready performance with an overall classification accuracy rate of 88 percent and a sensitivity rate of 95 percent. Membership in a math sequence cluster did not improve the classification accuracy of the decision tree.

The CART rules for identifying a student as at risk of failing to meet the ACT college readiness benchmark in math are generated in the analysis and are displayed visually in a decision tree (figure 2). The decision tree shows two rules for identifying students as at risk of failing to meet the ACT college readiness benchmark in math and two rules for identifying students as not at risk. The rules are derived using the criterion specified in each oval followed by a "yes" or "no" answer. All "yes" answers split to the left, and all "no" answers split to the right. Based on the CART model, the first criterion is whether a student scored less than 163 on the MCT2 in grade 5. If yes, the student is at risk of failing to meet the college readiness benchmark. Second, students who score 163–167 in math on the MCT2 in grade 5 and are Black or two or more races/ethnicities are classified as at risk.

Figure 2. Classification and regression tree model decision rules for identifying Mississippi students as at risk of failing to meet the ACT college readiness benchmark in math, based on grade 5 math achievement and race/ethnicity, 2011/12–2016/17



MCT2 is Mississippi Curriculum Test, Second Edition.

Source: Authors' analysis based on data from the Mississippi Department of Education.

Implications

The study found differences in math sequences in grades 6–11, with some sequences including more rigorous coursework than others. While math sequences became more diverse after grade 6, math sequence has no clear relationship with the likelihood of college-ready performance in math after grade 5 math achievement and race/ethnicity are controlled for. That college-ready performance is associated less with math sequence than with grade 5 math achievement suggests the need to focus on math instruction before grade 6. Algebra I is often viewed as a gatekeeper course, but math preparation in elementary school may also set students on the path to taking Algebra I earlier. While this study did not explore the quality of math curriculum and instruction in secondary school, the findings underscore the importance of math instruction in elementary school.

Because the study used data that many states routinely collect or that are publicly available, other states might explore their own datasets to identify the relationship between math sequence and college-ready performance. Many transcript studies focus on coursework completed in high school, but the current study suggests that understanding college readiness in math could begin much earlier.

Limitations

Because of the study's nonexperimental design, it cannot determine cause and effect. The association between math score on the MCT2 in grade 5 and ACT math score in grade 11 does not mean that grade 5 achievement causes grade 11 performance. But the association can be used to identify potential problem areas and to provide some evidence of promising avenues to pursue.

The cohort being studied entered high school in 2014/15 under the state's new academic standards, but it had completed its middle school coursework under the old standards. In addition, the MCT2 in grade 5 was replaced in 2015/16 after the study sample had been assessed in grade 5. Therefore, the findings of this study may not apply to other cohorts of students. Subsequent studies may consider including the cohort that entered middle school in 2014/15 under the new standards and new suggested minimum course sequences (once those data are available) or a later cohort assessed with the new grade 5 assessment.

Grades or credits earned, as well as differences in curriculum materials and instructional quality across math sequences, were not considered because they were beyond the scope of the study. Associations between math sequences and ACT performance could be driven by unobserved differences in curriculum.

Other limitations relate to the exclusion of some groups of students: private school students, students who leave or enter the Mississippi public school system during their secondary education, and students with missing test scores. In addition, the coding method for taking a combination of courses in a given grade does not take into account whether multiple courses occurred at the same time or by semester through a block schedule.

The ACT math scores used in the study are from the required Mississippi Department of Education statewide administration of the ACT in grade 11 and do not include ACT scores earned before or after the statewide administration. In addition, because students are not required to achieve a college-ready score, some bias may exist due to differences in student motivation. Finally, the ACT math score is not representative of the full content of math and may not reflect a student's true college readiness.

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