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Student group differences in Arkansas' indicators of postsecondary readiness and success

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Student group differences in Arkansas' indicators of postsecondary readiness and success

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Regional Educational Laboratory Southwest partnered with the Arkansas Department of Education (ADE) to examine Arkansas's middle and high school indicators of postsecondary readiness and success, building on an earlier study of these indicators (Hester et al., 2021). Academic indicators include attaining proficiency on state achievement tests, grade point average, enrollment in advanced courses, and community service learning. Behavioral indicators include attendance, suspension, and expulsion. Using data on statewide grade 6 cohorts from 2008/09 and 2009/10, the study examined the percentages of students who attained the readiness and success indicators and the percentages of students who attained postsecondary readiness and success outcomes by gender, race/ethnicity, eligibility for the National School Lunch Program, English learner student status, disability status, age, and district locale. The study also examined whether the predictive accuracy, specificity, and strength of the indicators varied by these student groups.

Three key findings emerged. First, the attainment of indicators of postsecondary readiness and success differed substantially for nearly all student groups, with the number of substantial differences on academic indicators exceeding those on behavioral indicators. The largest number of substantial differences in the attainment of academic indicators were between Black and White students, between students eligible and ineligible for the National School Lunch Program (an indicator of economic disadvantage), and between students who entered grade 6 before and after age 13. Second, attainment of postsecondary readiness and success outcomes varied substantially across student groups, with the largest differences between students with and without a disability. Third, predictive accuracy (the percentage of students with the same predicted and actual outcomes) and strength (the relative importance of a single indicator) were similar across student groups in most cases.

Leaders at ADE and in Arkansas districts can use these findings to identify appropriate indicators of postsecondary readiness and success and to target supports toward student groups who most need them. These findings can help leaders identify and address disparities such as inequitable access to resources and supportive learning environments.

Why this study?

The Arkansas Department of Education's (ADE's) vision for educational excellence is that each student graduates from high school prepared for college, career, and community engagement (ADE, 2019).

To monitor progress toward preparing students for college in particular, ADE identified school quality and student success indicators for its Every Student Succeeds Act (ESSA) state plan. The department chose indicators that they hypothesized would relate to postsecondary readiness and success. To confirm their hypotheses, ADE partnered with Regional Educational Laboratory Southwest in 2021 to study how well these indicators predicted Arkansas students' postsecondary readiness and success (Hester et al., 2021). The study found that indicators based on performance in middle and high school, when combined with student background characteristics (for example, gender, race/ethnicity, eligibility for the National School Lunch Program), predicted postsecondary readiness (an ACT score of 19 or higher) and success (college enrollment and persistence) with greater accuracy than did student background characteristics alone (Hester et al., 2021).

For additional information, including background on the study, technical methods, and supporting analyses, access the report appendices at https://ies.ed.gov/ncee/rel/Products/Publication/100916

These findings suggest that ADE and Arkansas districts could use the indicators in Arkansas' ESSA state plan to identify students who may require extra support. However, the earlier study did not examine differences across student groups in attaining indicators of postsecondary readiness and success, and it did not examine whether the predictive accuracy, specificity, or strength of the indicators varied for groups of students with different background characteristics, referred to as student groups.

Before using the indicators identified in the earlier report, ADE wanted to better understand how well they perform for student groups. Accordingly, ADE partnered with the Regional Educational Laboratory Southwest to conduct a follow-up study. This study provides information about differences in the percentages of students who attained both indicators of postsecondary readiness and success and postsecondary readiness and success outcomes by gender, race/ethnicity, eligibility for the National School Lunch Program (an indicator of economic disadvantage), English learner student status, disability status, age, and district locale. It also provides information about differences in how well the indicators perform (based on predictive accuracy, specificity, and strength) for students with these characteristics. All three metrics—predictive accuracy, specificity, and strength—are necessary to ensure the validity and practical value of a set of indicators that are combined in a statistical model. Predictive accuracy and specificity evaluate the overall quality of the model, and predictive strength evaluates the relative importance of an individual indicator.

Leaders at ADE and in Arkansas districts can use these findings to identify an appropriate set of indicators for postsecondary readiness and success. Indicators selected by ADE or Arkansas districts can be monitored and used to guide decisions about how best to target supports toward student groups who most need them. These findings also can help leaders identify and address disparities such as inequitable access to resources or supportive learning environments. Education leaders in other states and districts also may benefit from the findings, which add to the body of literature focused on improving postsecondary readiness and success for all students. (For a recent survey, see Davis et al. [2017] and Harackiewicz & Priniski [2018]).

Research questions

This study addressed four research questions:

1. Does the percentage of Arkansas students who attain indicators of postsecondary readiness and success vary by student group?
2. Does the percentage of Arkansas students who attain postsecondary readiness and success outcomes vary by student group?
3. How accurately and specifically do the indicators predict attainment of postsecondary readiness and success outcomes for different student groups?
4. How does the strength of the indicators for predicting postsecondary readiness and success outcomes vary by student group?

Key terms used in this report are defined in box 1. The data sources, study sample, methods, and limitations are summarized in box 2. (See appendix A for additional information.)

Box 1. Key terms

Indicators of postsecondary readiness and success. Measures of student academic and behavioral experiences in middle and high school that may predict future postsecondary readiness and success. This study examined the school quality and student success indicators in the Arkansas Every Student Succeeds Act (ESSA) state plan for which data were available.

The middle school indicators include the following:

- Scored proficient or higher on a grade 8 state English language arts assessment.
- Scored proficient or higher on a grade 8 state mathematics assessment.
- Scored proficient or higher on the grade 7 state science assessment.
- Present more than 95 percent of the days enrolled for all years.

- Present 90 percent or less of the days enrolled (chronically absent) in any year.
- Never suspended.
- Never expelled.
- The high school indicators include the following[1]:
- Scored proficient or higher at least once on a state mathematics assessment.
- Scored proficient or higher on a state science assessment.
- Attained a grade point average of 2.8 or higher.
- Enrolled in at least one advanced course (Advanced Career Education, Advanced Placement, or International Baccalaureate).
- Enrolled in at least one community service learning course.
- Present more than 95 percent of the days enrolled for all years.
- Present 90 percent or less of days the enrolled (chronically absent) in any year.
- Never suspended.
- Never expelled.

In high school, student data from grades 9 and 10 were used to construct indicators to predict the postsecondary readiness outcome, and student data from grades 9–12 were used to construct indicators to predict postsecondary success outcomes.

Postsecondary readiness outcome. A score of 19 or higher on the ACT examination (offered to all grade 11 public school students in Arkansas free of charge), which is the score specified in the Arkansas ESSA state plan.

Postsecondary success outcomes. This study examined two postsecondary success outcomes:

- College enrollment. Enrolled for at least one term in college, regardless of the degree or certificate pursued, within eight years of beginning grade 6 (that is, within two years of expected on-time high school graduation).
- College persistence. Enrolled for more than one term in college within eight years of beginning grade 6, including enrollment in nonconsecutive terms and enrollment in more than one institution.

Predictive accuracy. The percentage of all students with the same predicted and actual outcomes (that is, true positives or true negatives), based on logistic regression models. A true positive is when a student who was predicted to attain readiness or success attained the outcome. A true negative is when a student who was predicted not to attain readiness or success did not attain the outcome. A false positive is when a student who was predicted to attain readiness or success did not attain the outcome. A false negative is when a student who was predicted not to attain readiness or success attained the outcome.

Predictive specificity. The percentage of students the model predicted would not attain postsecondary readiness and success from those who did not attain those outcomes, based on logistic regression models. Predictive specificity informs decisionmakers about the model's capacity to identify which students do not achieve the desired outcomes, which often is administrators' primary concern.

Predictive strength. A measure of the strength of the association between an indicator and an outcome estimated from a logistic regression model that controls for other indicators and student background characteristics. Predictive strength isolates the effect of a single indicator on the probability of success when many interrelated factors may affect the outcome. This study operationalizes predictive strength as the **marginal effect** of an indicator on the outcome: the average percentage point difference in the probability of achieving a given outcome between students who did and did not attain an indicator, adjusting for the differences in all other characteristics and indicator values.

Substantial difference. A difference of 10 percentage points or more between students with different characteristics (for example, between male and female students or between students who are eligible for the National School Lunch Program and students who are not eligible).

Note

1. No high school English language arts assessment was available for the cohorts in the study.

Box 2. Data sources, sample, methods, and limitations

Data sources. This study used administrative data provided by the Arkansas Department of Education (ADE), the Arkansas Division of Higher Education, and the National Student Clearinghouse and publicly available data from the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.). A full description of data elements, data sources, and variables used in the study is in appendix A.

ADE provided data on the characteristics of grade 6 students in all districts in the state in 2008/09 or 2009/10, including a unique student and school identification number, background characteristics, academic and behavioral measures in middle and high school (ACT scores, standardized test scores in English language arts and mathematics, high school course transcripts, attendance, and discipline), and college enrollment and persistence (enrolled in two terms or more). The study examined seven background characteristics, all measured in grade 6. The Arkansas Division of Higher Education and the National Student Clearinghouse provided data on college enrollment and persistence for grade 6 students in all districts in the state in 2008/09 or 2009/10 for up to eight years after high school graduation (2016/17 or 2017/18).

The study team obtained publicly available data on districts' locale (city, suburb, or town/rural area) from the Common Core of Data (U.S. Department of Education, n.d.).

Sample. The study examined 63,679 grade 6 students in Arkansas public schools in 2008/09 or 2009/10 and tracked these students for eight additional years, until 2016/17 (for the 2008/09 cohort) or 2017/18 (for the 2009/10 cohort). Students who enrolled in later grades and years but were not enrolled in grade 6 in 2008/09 or 2009/10 were excluded from the analysis. Student ACT scores were missing in approximately 40 percent of the cases. Records with missing values were excluded from the main analysis, which resulted in a sample of 37,930 for analyses related to postsecondary readiness (defined as achieving a 19 or higher on the ACT).[1] The results of an alternative analysis that treated all missing ACT scores as 0 are in appendix C.

Methodology. For all research questions, the study team aggregated data separately across the middle school years and the high school years when constructing indicators. For models that included high school indicators as predictors of postsecondary readiness (ACT score of 19 or higher), the study team used information from grades 9 and 10 to construct indicators because the readiness outcome was assessed in the spring of grade 11 for most students. The study team used information from grades 9–12 to construct high school indicators to predict the postsecondary success outcomes because college enrollment and persistence were measured after high school completion.

The study team conducted two simultaneous processes to assess the extent to which the percentage of Arkansas students who attained indicators of postsecondary readiness and success (research question 1) and postsecondary readiness and success outcomes (research question 2) varied by student group. These processes were as follows:

- Calculated descriptive statistics for proportions and analyzed the statistical significance of intergroup differences in the rates of attainment using t tests for proportions.
- Conducted pairwise comparisons for binary (yes/no) variables (for example, male versus female and students eligible for the National School Lunch Program versus those not eligible) and against the majority category for race/ethnicity (White versus Black, Hispanic, or another race/ethnicity) and district locale (suburb versus city or town/rural area).

The study team considered differences that were 10 percentage points or greater to be substantial (Hester et al., 2021). These differences are highlighted in the main report.

To understand how accurately the indicators predict attainment of postsecondary readiness and success outcomes for different student groups (research question 3), the team used logistic regression models. Six models were estimated in the main analysis: two models for each of the three outcome types (postsecondary readiness, college enrollment, and college persistence), with one model including middle school indicators and the other including high school indicators. All models included student background characteristics and a set of interaction terms. For each model, the predictive accuracy and specificity (see box 1 for definitions) of the set of middle and high school indicators were calculated by outcome and student group. To make comparisons of predictive accuracy and specificity, the team considered differences of 10 percentage points or greater to be substantial. Details of the model design and the calculations of predictive accuracy and specificity are in appendix B.

To address research question 4, the team used the models developed to address research question 3, focusing on the predictive strength (or marginal effect; see box 1) between individual indicators and outcomes for each student group relative to the reference group. For each model, marginal effects were estimated separately for each student group and compared with the marginal effects estimated for the reference group.

Limitations. This study has three primary limitations. First, to examine longitudinal outcomes for students between grade 6 and the second year after high school graduation, the study used data on students who entered middle school more than a decade ago. Therefore, the study findings may not apply to current students, who face different educational circumstances because of the COVID-19 pandemic and evolving academic standards. Second, with the dataset constrained to two annual cohorts of students, it is not possible to establish if changes in the observed patterns occurred across time. The study results are accurate for predicting the future only if the patterns in intergroup differences remain the same as they were for the two cohorts studied. Third, the study uses binary pass/fail indicators. The cut points may obscure underlying relationships between continuous metrics such as ACT scores and the number of years of college completed. However, the use of binary indicators simplifies the interpretation and practical use of the results. Ideally, researchers would explore a variety of alternative thresholds and identify those that predict particular student outcomes most efficiently.

Note

1. Meaningful differences exist in the characteristics of students who had ACT scores and those who did not. Students with ACT scores were more likely to be female and White; they were less likely to be eligible for the National School Lunch Program and to have a disability (see table A2 in appendix A).

Attainment of indicators of postsecondary readiness and success

This section presents findings on the percentages of Arkansas students who attained indicators of postsecondary readiness and success in middle and high school, as well as differences in attainment by student group. Results from the supporting analyses are in appendix B.

Substantial differences in attaining academic indicators of postsecondary readiness and success occurred for most student groups

The largest number of substantial differences in attaining academic indicators of postsecondary readiness and success were between Black and White students, between students eligible for the National School Lunch Program and students not eligible, and between students who entered grade 6 after age 13 and students who did not. For each of these student groups, substantial differences occurred for seven of the eight indicators (table 1, last column). Substantial differences occurred in six indicators for students with disabilities compared with students without disabilities, and substantial differences occurred in five indicators for both Hispanic students compared with White students and English learner students compared with non-English learner students. Male students were substantially less likely than female students to attain three academic indicators, and students who attended schools in cities were substantially less likely than students who attended schools in suburbs to attain two indicators.

The indicator with the greatest number of substantial differences across student groups was grade point average of 2.8 or higher. No substantial differences across student groups occurred in enrollment in community service learning courses.

Table 1. Percentages of Arkansas students attaining academic indicators of postsecondary readiness and success by student group, 2008/09 and 2009/10 grade 6 cohorts

Student group	Middle school academic indicators			High school academic indicators					Number of substantial differences per student group
	Mathematics proficiency	Science proficiency	English language arts proficiency	Mathematics proficiency	Science proficiency	GPA 2.8+	Enrollment in advanced courses	Enrollment in community service learning courses	
Gender									
Female	68.9	34.8	84.3*	69.0	43.1[a]	56.6*	52.8*	4.2	3
Male^	66.5	37.5	71.3	66.8	42.7	38.3	37.6	3.4	na
Race/ethnicity									
Black	43.5*	12.5*	61.4*	45.6*	19.1*	27.0*	31.2*	1.5	7
Hispanic	63.7*	24.4*	74.6	65.5*	32.1*	39.3*	43.2	5.2	5
Other	73.6	42.0	81.6	67.7	49.9	55.4[a]	52.5	5.0[a]	0
White^	76.4	45.9	83.6	76.0	52.4	55.1	49.8	4.4	na
Eligible for the National School Lunch Program									
Yes	57.6*	24.8*	69.9*	60.2*	31.5*	34.9*	33.8*	3.2	7
No^	82.8	53.5	89.4	79.4	60.1	65.7	62.0	4.7	na
English learner student									
Yes	54.5*	15.5*	67.4*	60.7	23.7*	32.9*	36.4	6.2	5
No^	68.5	37.5	78.3	68.3	44.1	48.1	45.6	3.6	na
Disability status									
Yes	28.5*	15.6*	33.1*	62.6	32.1*	28.6*	10.4*	3.2	6
No^	72.6	38.8	83.3	68.5	44.2	49.6	49.4	3.9	na
Entered grade 6 after age 13									
Yes	45.4*	20.9*	55.9*	54.3*	27.3*	28.4*	21.9*	3.4	7
No^	72.7	39.7	82.6	70.9	46.4	51.5	50.3	3.9	na
District locale									
City	63.8	34.3	75.1	61.4*	40.6	41.4*	45.0	4.5	2
Town or rural area	68.3	35.6	77.8	69.4	42.5	48.7	44.5	2.5	0
Suburb^	73.4	43.5	82.8	75.5	50.3	53.5	47.7	8.4	na
Number of substantial differences per indicator	*6*	*6*	*6*	*5*	*6*	*8*	*5*	*0*	*na*

^ denotes the reference group. * denotes differences of 10 percentage points or more from the reference group.
GPA is grade point average. na is not applicable.
Note: The sample included 63,679 grade 6 students in 2008/09 or 2009/10. The study team used information from grades 9–12 to construct indicators for GPA 2.8+, enrollment in advanced courses, and enrollment in community service learning courses. Other race/ethnicity includes students who were Asian, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and two or more races.
a. Not significantly different from the reference group at $p < 0.05$.
Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

Fewer differences between student groups for behavioral indicators occurred compared with differences between student groups for academic indicators of postsecondary readiness and success

The largest number of substantial differences in behavioral indicators was between students who were eligible for the National School Lunch Program, students with disabilities, and students who entered grade 6 after age 13 relative to students without these characteristics. However, for all of these groups, substantial differences occurred in four behavioral indicators (table 2, last column) compared with substantial differences in six or seven academic indicators (see table 1, last column). Substantial differences occurred in two behavioral indicators between Black and White students, and no substantial differences occurred between Hispanic students or students of other races/ethnicities and White students. Substantial differences also occurred in two behavioral indicators between female and male students.

The indicators with the most substantial differences across student groups were never suspended and attendance at a rate of 95 percent or more. Male students, Black students, students eligible for the National School Lunch Program, students with disabilities, and students who entered grade 6 after age 13 were less likely to avoid suspension than students without these characteristics. No substantial differences occurred for never expelled or 90 percent attendance or less in middle and high school.[1]

[1] Although rates of having never been expelled were close to 100, and the difference between Black students and White students in rates of having never been expelled was small (98.7 percent for Black students and 99.6 percent for White students in high school), the relative chance of being expelled was three times higher for Black students than for White students. Similarly, the relative chance of being chronically absent (90 percent or less attendance) was significantly higher for Black students than for White students, as well as for students eligible for the National School Lunch Program compared with those who are not and for students with disabilities compared with students without disabilities.

Table 2. Percentages of Arkansas students attaining behavioral indicators of postsecondary readiness and success by student group, 2008/09 and 2009/10 grade 6 cohorts

Student group	Middle school behavioral indicators				High school behavioral indicators				Number of substantial differences per student group
	Never suspended	Never expelled	90 percent attendance or less	95 percent attendance or more	Never suspended	Never expelled	90 percent attendance or less	95 percent attendance or more	
Gender									
Female	79.7*	99.8	6.8	46.4	73.2*	99.7	9.5	56.3	2
Male^	64.8	99.6	7.9	44.9	58.5	99.0	9.9	58.6	na
Race/ethnicity									
Black	49.2*	99.4	9.4	46.8	44.2*	98.7	13.9	55.2	2
Hispanic	72.9	99.6	6.7[a]	52.7	65.1	99.4[a]	7.9	59.8	0
Other	80.9[a]	99.8[a]	6.9[a]	50.5	73.9[a]	99.8[a]	7.6	64.1	0
White^	79.6	99.8	6.8	44.0	72.9	99.6	8.6	57.7	na
Eligible for the National School Lunch Program									
Yes	63.3*	99.5	9.8	40.0*	56.7*	99.1	13.4	50.1*	4
No^	85.3	99.9	3.7	54.1	79.1	99.8	4.2	68.6	na
English learner student									
Yes	71.4[a]	99.6[a]	7.3[a]	53.0	62.7	99.3[a]	8.6[a]	59.1	0
No^	72.1	99.7	7.4	45.2	65.9	99.3	9.8	57.4	na
Disability status									
Yes	62.0*	99.8[a]	11.6	35.1*	55.5*	99.3[a]	14.9	47.2*	4
No^	73.3	99.7	6.9	47.0	66.9	99.4	9.0	58.8	na
Entered grade 6 after age 13									
Yes	62.7*	99.4	12.0	36.1*	57.5*	99.0	16.1	47.5*	4
No^	74.2	99.8	6.4	47.8	67.5	99.4	8.3	59.7	na
District locale									
City	67.6	99.7	8.1	42.6	62.2	99.3	11.3	55.8	0
Town or rural area	73.5	99.7	7.1[a]	46.5	66.3	99.3	9.1[a]	57.8	0
Suburb^	75.7	99.9	7.3	48.4	70.8	99.7	9.2	60.2	na
Number of substantial differences per indicator	*5*	*0*	*0*	*3*	*5*	*0*	*0*	*3*	*na*

^ denotes the reference group. * denotes differences of 10 percentage points or more from the reference group.
na is not applicable.
Note: The sample included 63,679 grade 6 students in 2008/09 or 2009/10. The study team used information from grades 9-12 to construct the high school indicators. Other race/ethnicity includes students who were Asian, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and two or more races.
a. Not significantly different from the reference group at $p < 0.05$.
Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

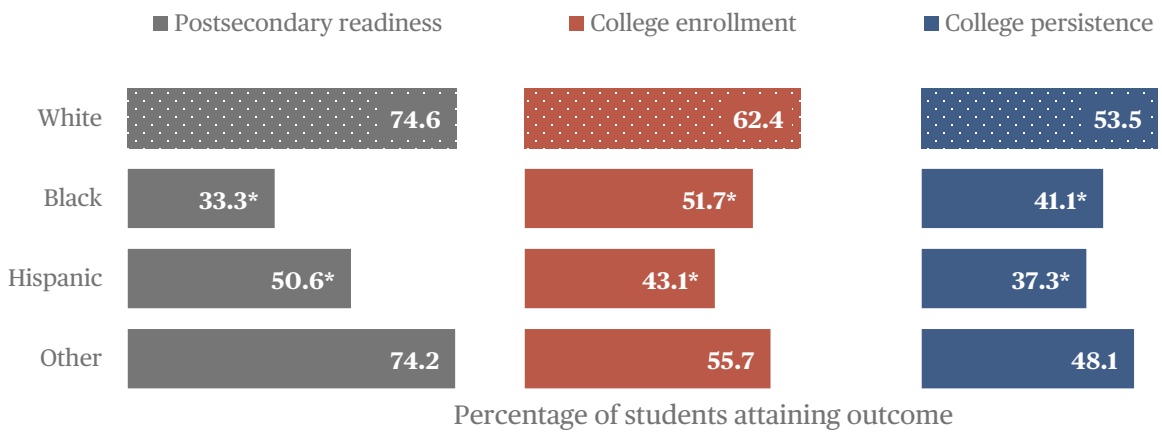
Attainment of postsecondary readiness and success outcomes

This section presents findings on the percentages of Arkansas students who attained postsecondary readiness and success outcomes, including an ACT score of 19 or higher, college enrollment, and college persistence.

Black and Hispanic students had substantially lower rates of postsecondary readiness and success than White students

Thirty-three percent of Black students and 51 percent of Hispanic students attained an ACT score of 19 or higher compared with 75 percent of White students (figure 1). Black and Hispanic students also were less likely than White students to enroll in and persist in postsecondary education. Fifty-two percent of Black students and 43 percent of Hispanic students enrolled in college, whereas 62 percent of White students enrolled in college. Forty-one percent of Black students and 37 percent of Hispanic students persisted in postsecondary education compared with 54 percent of White students.

Figure 1. Black and Hispanic students in Arkansas attained postsecondary readiness and success outcomes at lower rates than White students, 2008/09 and 2009/10 grade 6 cohorts



* denotes differences of 10 percentage points or more from the reference group.

Note: Reference group bars are pattern filled. The sample included 37,930 grade 6 students in 2008/09 or 2009/10 for postsecondary readiness (of these total observations, there were 26,443 White students, 7,648 Black students, 2,603 Hispanic students, and 1,136 students of other races/ethnicities). There were 63,679 students in grade 6 in 2008/09 or 2009/10 for college enrollment and persistence (of these total observations, there were 41,546 White students, 14,594 Black students, 5,665 Hispanic students, and 1,874 students of other races/ethnicities). Other race/ethnicity includes students who were Asian, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and two or more races. All differences were statistically significant except for the difference in postsecondary readiness between White students and students of other races/ethnicities.

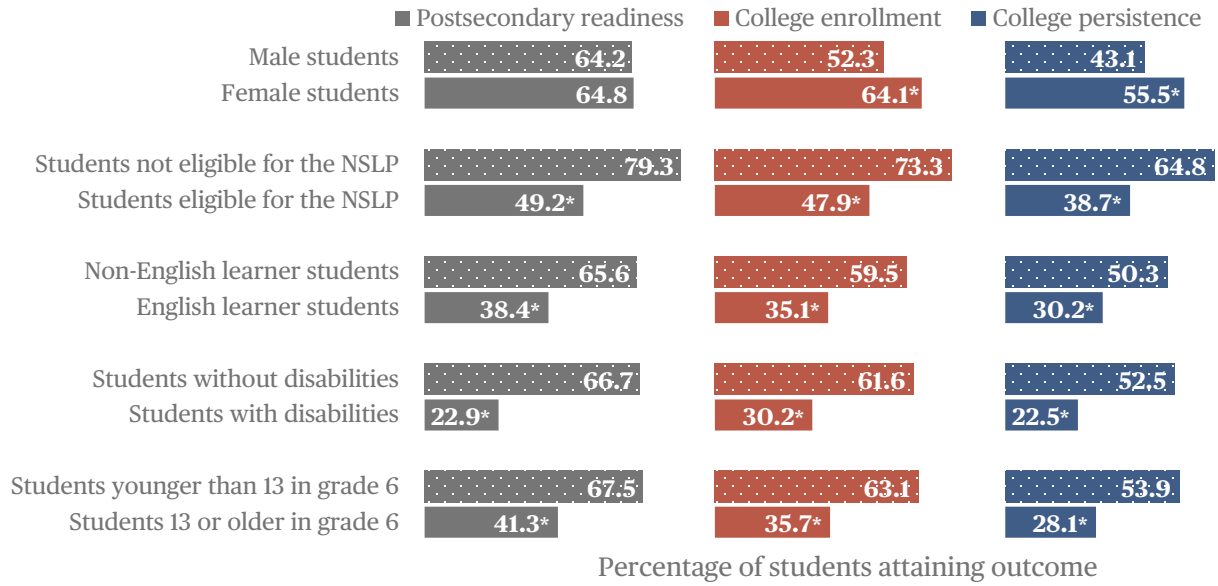
Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, and the National Student Clearinghouse.

Male students, students eligible for the National School Lunch Program, English learner students, students with disabilities, and students entering grade 6 after age 13 had substantially lower rates of postsecondary readiness and success

Not only were students with disabilities the least likely to be ready for, enroll in, and persist in college, but the largest difference between any reference group and its counterpart was between students with and without disabilities. Students with disabilities attained postsecondary readiness, enrolled in college, and persisted in college at a rate of about one half to one third that of students without disabilities (figure 2). English learner students, students eligible for the National School Lunch Program, and students who entered grade 6 after age 13 were less likely than students without these characteristics to attain postsecondary readiness, enroll in college,

and persist in college. For example, 48 percent of the students eligible for the National School Lunch Program enrolled in college compared with 73 percent of the students not eligible (see figure 2). Finally, female students had substantially higher rates of college enrollment and persistence than male students.

Figure 2. Male students, students eligible for the National School Lunch Program, English learner students, students with disabilities, and students entering grade 6 after age 13 in Arkansas attained postsecondary readiness and success outcomes at lower rates, 2008/09 and 2009/10 grade 6 cohorts

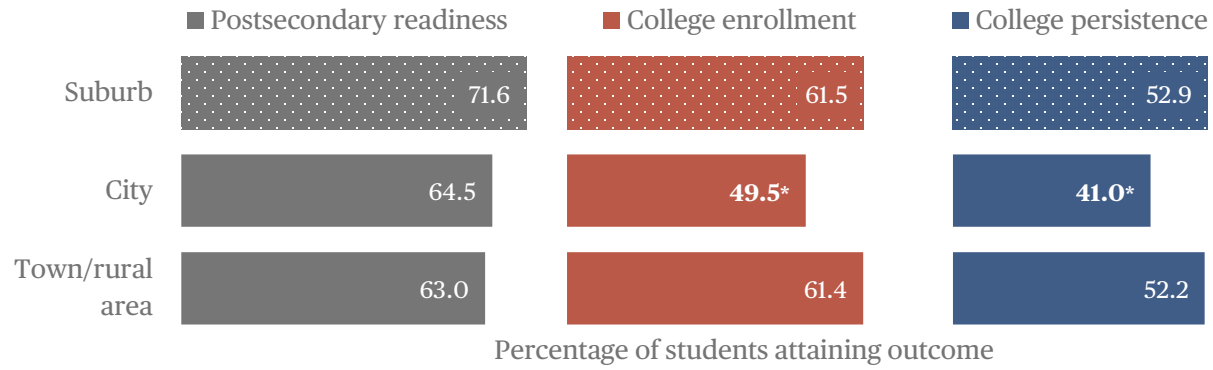


* denotes differences of 10 percentage points or more from the reference group.
NSLP is National School Lunch Program.
Note: Reference group bars are pattern filled. The sample included 37,930 grade 6 students in 2008/09 or 2009/10 for postsecondary readiness (of these observations, there were 17,072 male students, 20,858 female students, 18,568 students eligible for the National School Lunch Program, 1,553 English learner students, 1,879 students with disabilities, and 4,256 students entering grade 6 after age 13). There were 63,679 students in grade 6 in 2008/09 or 2009/10 for college enrollment and persistence (of these observations, there were 32,546 male students, 31,133 female students, 3,774 English learner students, 38,263 students eligible for the National School Lunch Program, 7,122 students with disabilities, and 11,727 students entering grade 6 after age 13). All differences were statistically significant except for the difference in postsecondary readiness between male and female students.
Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, and the National Student Clearinghouse.

Students who attended schools in cities had substantially lower rates of college enrollment and persistence than students who attended schools in suburbs; there was no substantial difference for students who attended schools in towns or rural areas

Students who attended schools in cities enrolled in and persisted in college at a rate of 12 percentage points below students who attended schools in suburbs, which was a substantial difference (figure 3). Attainment of postsecondary readiness was lower for students who attended schools in cities compared with students who attended schools in suburbs, but the difference was not substantial (7 percentage points). The difference between students who attended schools in towns or rural areas and students who attended schools in suburbs was not substantial for any outcome, differing by less than 1 percentage point for college enrollment and persistence and 9 percentage points for postsecondary readiness.

Figure 3. Students in Arkansas who attended schools in cities had substantially lower rates of college enrollment and persistence than students who attended schools in suburbs, 2008/09 and 2009/10 grade 6 cohorts



* denotes differences of 10 percentage points or more from the reference group.
Note: Reference group bars are pattern filled. The sample included 37,930 students in grade 6 in 2008/09 or 2009/10 for postsecondary readiness (9,778 students attended schools in cities, 24,556 students attended schools in towns or rural areas, and 3,596 students attended schools in suburbs). There were 63,679 students in grade 6 in 2008/09 or 2009/10 for college enrollment and persistence (18,011 students attended schools in cities, 39,949 students attended schools in towns or rural areas, and 5,719 students attended schools in suburbs). The only statistically significant differences were for college enrollment and persistence outcomes and between students in cities and suburbs.
Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, the National Student Clearinghouse, and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

Predictive accuracy and specificity of indicators of postsecondary readiness and success

This section describes key findings for the predictive accuracy and specificity of indicators of postsecondary readiness and success. Predictive accuracy (the percentage of students for whom the model accurately predicted that postsecondary readiness and success outcomes were or were not attained) and predictive specificity (the percentage of students for whom the model accurately predicted that postsecondary readiness and success outcomes were not attained) evaluate overall model quality.

There were no substantial differences in the accuracy with which middle and high school indicators predicted postsecondary readiness and success between student groups

Middle and high school indicators of postsecondary readiness and success predicted postsecondary readiness, college enrollment, and college persistence with an overall accuracy that did not vary substantially between students with different characteristics (see table B2 in appendix B).

The specificity of predicting whether a student did not attain postsecondary readiness and success was substantially higher for students eligible for the National School Lunch Program, English learner students, students with disabilities, and students entering grade 6 after age 13 relative to students without these characteristics

The largest difference in predictive specificity when predicting college enrollment was for middle school students with disabilities (table 4). The middle school model correctly predicted 95 percent of the cases in which students with disabilities would not enroll in college compared with just 51 percent of the cases in which students without disabilities would not enroll in college, a 44 percentage point difference.

Table 4. Predictive specificity of models using middle and high school indicators of postsecondary readiness and success of Arkansas students, by student group, 2008/09 and 2009/10 grade 6 cohorts

Student group	Middle school			High school		
	Postsecondary readiness	College enrollment	College persistence	Postsecondary readiness	College enrollment	College persistence
Gender						
Female	67.0	48.2*	57.5*	74.6	65.0*	69.8*
Male^	68.7	67.3	74.9	74.2	78.5	82.0
Race/ethnicity						
Black	90.2*	66.7*	77.6*	89.9*	76.0	84.5*
Hispanic	73.9*	75.2*	81.8*	80.6*	79.3	82.8*
Other	56.0	59.2	63.8	63.8	70.2	71.2
White^	50.1	52.7	60.5	61.9	70.3	72.5
Eligible for the National School Lunch Program						
Yes	76.0	68.7*	79.1*	81.4*	79.5*	84.2*
No^	48.4	31.8	37.0	58.1	53.4	57.3
English learner student						
Yes	83.2*	85.4*	91.0*	87.2*	85.4*	88.4*
No^	66.6	56.7	65.4	73.4	71.6	75.7
Disability status						
Yes	93.2*	94.5*	97.9*	94.9*	93.9*	96.4*
No^	64.7	51.3	61.2	71.9	68.0	72.7
Entered grade 6 after age 13						
Yes	85.8*	87.3*	92.0*	86.3*	89.7*	92.5*
No^	63.7	48.3	58.8	71.7	66.2	71.3
District locale						
City	72.0	67.9*	75.9*	77.6	78.2	80.6
Town or rural area	66.7	54.6	63.6	74.0	69.5	75.1
Suburb^	63.8	56.5	62.2	68.7	72.9	73.7

^ denotes the reference group. * denotes differences of 10 percentage points or more from the reference group.

Note: The sample included 37,930 students for postsecondary readiness and 63,679 students for college enrollment and persistence in grade 6 in 2008/09 or 2009/10. Other race/ethnicity includes students who were Asian, Native American/Alaska Native, Native Hawaiian/Pacific Islander, and two or more races. The study team used information from grades 9 and 10 to construct high school indicators to predict postsecondary readiness and information from grades 9–12 to construct high school indicators to predict college enrollment and persistence.

Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, the National Student Clearinghouse, and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

Predictive strength of middle and high school indicators of postsecondary readiness and success

This section presents the results of the analysis of the predictive strength of indicators of postsecondary readiness and success with a focus on the differences between student groups. Predictive accuracy and specificity provide information about overall model quality, and predictive strength provides information about the relative importance of individual indicators. Although the findings from the study should not be interpreted as causal, information on the relative predictive strength of indicators can help leaders at ADE prioritize indicators that can be monitored and used to guide decisions about how best to target supports toward student groups who most need them.

Almost all middle and high school academic indicators demonstrated similar predictive strength across student groups

Predictive strength for almost all middle and high school academic indicators was similar across student groups, except for science and English language arts proficiency in middle school and science proficiency and enrollment in community service learning courses in high school (table 5).

Table 5. Number of substantial differences in the predictive strength of academic indicators of postsecondary readiness and success outcomes across student groups in Arkansas, 2008/09 and 2009/10 grade 6 cohorts

Postsecondary readiness and success outcomes	Middle school academic indicators			High school academic indicators				
	Mathematics proficiency	Science proficiency	English language arts proficiency	Mathematics proficiency	Science proficiency	GPA 2.8+	Enrollment in advanced courses	Enrollment in community service learning courses
Postsecondary readiness	0	0	1	0	0	0	na	na
College enrollment	0	1	1	0	1	0	0	1
College persistence	0	1	1	0	1	0	0	0

GPA is grade point average. na is not applicable.

Note: The sample included 37,930 students for postsecondary readiness and 63,679 students for college enrollment and persistence in grade 6 in 2008/09 or 2009/10. The study team used information from grades 9 and 10 to construct high school indicators to predict postsecondary readiness and information from grades 9–12 to construct high school indicators to predict college enrollment and persistence. The number of possible differences for each indicator is 10 across two genders, four race/ethnicity groups, two National School Lunch Program eligibility groups, two English learner student status groups, two disability status groups, two age groups, and three district locale groups.

Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, the National Student Clearinghouse, and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

In middle school, English language arts and science proficiency were the only academic indicators that varied substantially by student characteristics in their predictive strength. English language arts proficiency was the only middle school academic indicator that varied substantially in its predictive strength for postsecondary readiness (see table B3 in appendix B), and English language arts proficiency and science proficiency were the only middle school academic indicators that varied substantially in their predictive strength for college enrollment and persistence (see tables B4 and B5 in appendix B). For postsecondary readiness, the predictive strength of English language arts proficiency varied substantially by race/ethnicity. Predictive strength was the highest for Black and Hispanic students and lowest for White students and for students of other races/ethnicities. Hispanic students who achieved English language arts proficiency in middle school were 30 percentage points more likely to attain

postsecondary readiness; White students were only 19 percentage points more likely to attain postsecondary readiness (see table B3 in appendix B).

For college enrollment, the predictive strength of English language arts proficiency varied substantially by race/ethnicity, and the predictive strength of science proficiency varied substantially by disability status. Students of other races/ethnicities who achieved English language arts proficiency in middle school were 24 percentage points more likely to enroll in college, whereas White students who achieved English language arts proficiency in middle school were 14 percentage points more likely to enroll in college (see table B4 in appendix B). Students with disabilities who achieved science proficiency in middle school were 10 percentage points less likely to enroll in college, whereas students without disabilities who achieved science proficiency in middle school were 9 percentage points more likely to enroll in college.

For college persistence, the predictive strength of English language arts proficiency and science proficiency varied substantially by disability status. Students with disabilities who achieved English language arts proficiency in middle school were 4 percentage points more likely to persist in college, whereas students without disabilities who achieved English language arts proficiency in middle school were 16 percentage points more likely to persist in college (see table B5 in appendix B). Similar to college enrollment, students with disabilities who achieved science proficiency in middle school were 8 percentage points less likely to persist in college, whereas students without disabilities who achieved science proficiency in middle school were 9 percentage points more likely to persist in college.

It is possible that the negative relationship between science proficiency and college enrollment and persistence for students with disabilities was a statistical artifact of the low rates of proficiency in science and college enrollment among students with disabilities. Only 16 percent of the students with disabilities who were proficient in middle school science enrolled in college, which was about 0.5 percent of the entire sample. In addition, measurement bias may occur when students with disabilities take an alternative version of the science standardized test or have testing accommodations.

Almost all high school academic indicators demonstrated similar predictive strength across student groups. No high school academic indicator varied substantially in predictive strength for postsecondary readiness (see table B3 in appendix B). However, for college enrollment and persistence, science proficiency varied substantially in predictive strength for students with disabilities (see tables B4 and B5 in appendix B). Students with disabilities who achieved science proficiency in high school were 9 percentage points less likely to enroll in college, whereas students without disabilities who achieved science proficiency in high school were 4 percentage points more likely to enroll in college. Similarly, students with disabilities who achieved science proficiency in high school were 7 percentage points less likely to persist in college, whereas students without disabilities who achieved science proficiency in high school were 3 percentage points more likely to persist in college. As with science proficiency in middle school, it is possible that the negative relationship between science proficiency in high school and college enrollment and persistence for students with disabilities was a statistical artifact of the low rates of proficiency in science and college enrollment, or possible use of alternative science standardized tests or testing accommodations among students with disabilities.

Enrollment in community service learning courses also varied substantially in its predictive strength for college enrollment. Black students who participated in a community service learning course in high school were 10 percentage points more likely to enroll in college, whereas there was no difference in college enrollment for White students who did or did not participate in a community service learning course (see table B4 in appendix B). Black female students who participated in a community service learning course in high school were even more likely to enroll in college, with a 14 percentage point higher rate of enrollment, which can be calculated by adding the predictive strength of both student groups.[2]

[2] Composite scores (adding the predictive strength of two groups) cannot be appropriately calculated for all combinations of characteristics because some characteristics are correlated, such being an English learner student and Hispanic.

All middle school and most high school behavioral indicators demonstrated similar predictive strength across all student groups, except for never expelled in high school. ***For the high school indicator never expelled, differences in its predictive strength were substantial for several student groups (table 6).*** Hispanic students, English learner students, students entering grade 6 after age 13, and students who attended schools in towns or rural areas were substantially more likely than their counterparts to enroll in college if they were never expelled (figure 4; see table B7 in appendix B). For Hispanic students, not being expelled in high school increased the likelihood of college enrollment by 46 percentage points compared with 14 percentage points for White students. There also were large increases in college enrollment for English learner students compared with non-English learner students, for students who entered grade 6 after age 13 relative to students who were younger than 13 when they entered grade 6, and for students who attended schools in towns or rural areas relative to students who attended schools in suburbs.

Table 6. Number of substantial differences in the predictive strength of behavioral indicators of postsecondary readiness and success outcomes across student groups in Arkansas, 2008/09 and 2009/10 grade 6 cohorts

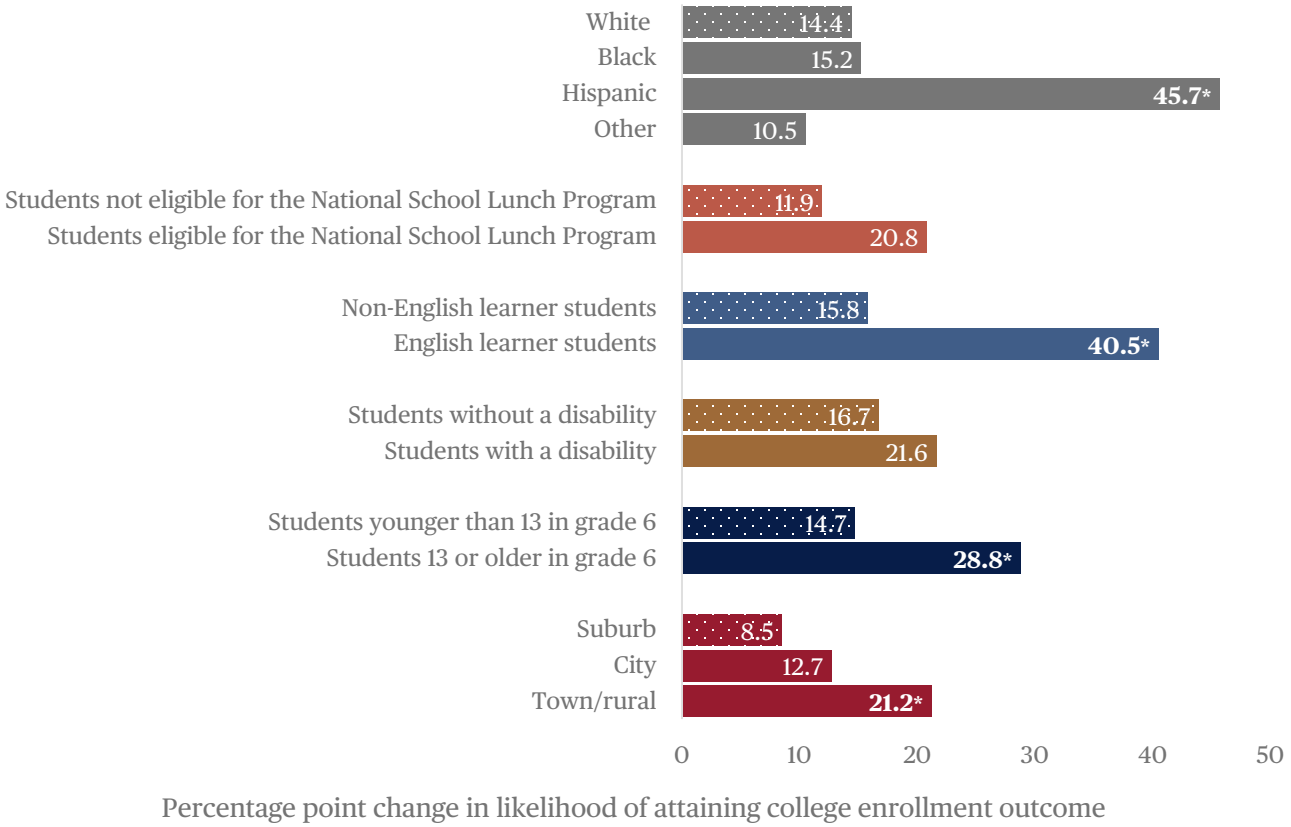
Postsecondary readiness and success outcomes	Middle school behavioral indicators				High school behavioral indicators			
	Never suspended	Never expelled	95 percent attendance or more	90 percent attendance or less	Never suspended	Never expelled	95 percent attendance or more	90 percent attendance or less
Postsecondary readiness	0	na	0	0	0	0	0	0
College enrollment	0	na	0	0	0	4	0	0
College persistence	0	na	0	0	0	1	0	0

na is not applicable.

Note: The sample included 37,930 students for postsecondary readiness and 63,679 students for college enrollment and persistence in grade 6 in 2008/09 or 2009/10. The study team used information from grades 9 and 10 to construct high school indicators to predict postsecondary readiness and information from grades 9–12 to construct high school indicators to predict college enrollment and persistence. The number of possible differences for each indicator is 10 across two genders, four race/ethnicity groups, two National School Lunch Program eligibility groups, two English learner student status groups, two disability status groups, two age groups, and three district locale groups.

Source: Authors' analysis of data from 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, the National Student Clearinghouse, and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

Figure 4. Predictive strength of not being expelled in high school as an indicator of college enrollment was substantially different for several student groups in Arkansas, 2008/09 and 2009/10 grade 6 cohorts



* denotes differences of 10 percentage points or more from the reference group.
Note: Reference group bars are pattern filled. The sample included 63,679 grade 6 students in 2008/09 or 2009/10. (Of these total observations, there were 41,546 White students, 14,594 Black students, 5,665 Hispanic students, and 1,874 students of other race/ethnicities. There were 38,263 students eligible for the National School Lunch Program, 3,774 English learner students, 7,122 students with disabilities, and 11,727 students entering grade 6 after age 13. There were 18,011 students who attended schools in cities, 39,949 students who attended schools in towns or rural areas, and 5,719 students who attended schools in suburbs.)
Source: Authors' analysis from data for 2008/09 to 2017/18 from the Arkansas Department of Education, the Arkansas Division of Higher Education, the National Student Clearinghouse, and the National Center for Education Statistics' Common Core of Data (U.S. Department of Education, n.d.).

For college persistence, there was one substantial difference in never being expelled, for students who entered grade 6 after age 13 compared with students who entered before age 13. For students who entered grade 6 after age 13, not being expelled in high school increased the likelihood of college persistence by 36 percentage points compared with 15 percentage points for students who entered grade 6 before age 13 (see table B8 in appendix B).

Implications

The findings from this study have several implications for leaders at ADE and in Arkansas districts.

First, leaders at ADE and in Arkansas districts could consider ways to equitably allocate resources to address disparities in attainment of postsecondary readiness and success indicators and outcomes. The study found that Black and Hispanic students, students eligible for the National School Lunch Program, students with disabilities, English learner students, and students who entered grade 6 after age 13 were less likely than students without these characteristics to attain indicators of postsecondary readiness and success, particularly academic indicators such as proficiency on state assessments in middle school and high school and achieving a grade point average of 2.8 or higher in high school. Students who do not attain these indicators, which are strong predictors of postsecondary readiness and success outcomes, may lack access to opportunities that support achievement.

In addition, ADE and Arkansas districts may want to focus on indicators that demonstrate differences in predictive strength across student groups, including English language arts proficiency in middle school, science proficiency in middle and high school, and having never been expelled in high school. For example, the study found that having never been expelled in high school was a stronger predictor of postsecondary enrollment for Hispanic students, English learner students, students who entered grade 6 after age 13, and students from towns or rural areas than for students without these characteristics. These findings suggest that performance on these indicators is more important for the success of students who are from historically marginalized groups. Such an interpretation is consistent with literature showing that education and behavioral indicators (for example, earning a college degree and not having been involved in the justice system) disproportionately benefit Hispanic and Black individuals (Card, 1999; Holzer et al., 2006).

Taken together the findings underscore the importance of ensuring equitable access to high-quality learning environments and providing academic and behavioral intervention using culturally competent strategies to address disparities. Research suggests that one strategy for ensuring equitable access to high-quality learning environments is to combine cultural responsiveness with tiered interventions that become increasingly targeted for identified students (Dee & Penner, 2017; Gutierrez et al., 2018; Utley & Obiakor, 2015). Specifically, research shows that instructional practices that integrate aspects of a students' community and home environment can improve students' academic achievement (Dee & Penner, 2016; Lewis et al., 2006). One example of tiered intervention currently used in Arkansas is positive behavioral intervention and supports, which can align with culturally relevant educational supports. Many strategies have been identified for integrating positive behavioral intervention and supports with culturally relevant educational services, including sustained guidance and oversight by school leaders (Betters-Bubon et al., 2016; Cothran & Ennis, 2000; Petrasek et al., 2022).

Second, and consistent with the findings from the prior study on Arkansas indicators of postsecondary readiness and success (Hester et al., 2021), leaders at ADE could continue to use the indicators included in its ESSA state plan to monitor students' postsecondary readiness. The study found that usually, the models predict postsecondary readiness and success outcomes with similar accuracy, specificity, and strength for students with different characteristics. These findings may suggest that the indicators are equitably suited for predicting postsecondary readiness and success and thus can be used as part of a system to systematically identify students who need extra support. Early warning systems have been used in education broadly speaking to provide accessible and timely information that can guide decisions about early intervention for students at risk of not achieving desired outcomes, including postsecondary readiness and success (Bowers et al., 2012; Dynarski et al., 2008; Stephan et al., 2015; Wentworth & Nagaoka, 2020). Arkansas may benefit from using an early warning system that includes the indicators of postsecondary readiness and success studied or integrating the indicators into their student success plans—particularly those indicators that would use data collected multiple times per year. Subsequent analyses would be required to ensure that the appropriate time points from the indicators are integrated into those models aiming to enable more contemporaneous decisionmaking.

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