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Development and examination of an alternative school performance index in South Carolina

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Key findings

- The measures that make up each of the three school performance indices currently used in South Carolina to rate schools can be consolidated using a bi-factor model to create an overall, reliable alternative index of school performance.
- Under the alternative index of school performance, about 3 percent of elementary schools, 2 percent of middle schools, and 3 percent of high schools performed better than expected (beat the odds), given the schools' demographic characteristics.
- Most of the school demographic profiles identified by the study contained at least one school that was beating the odds.

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Summary

Administrators from the South Carolina Department of Education partnered with Regional Educational Laboratory Southeast to test the extent to which the state's measures of school performance could be consolidated into an overall, reliable index that can be used to rate schools under the state's Elementary and Secondary Education Act waiver. In addition, the department was interested in using the new index to identify schools that are high and low performing after school demographic characteristics are controlled for.

At the time of this report's publication, South Carolina rated school performance using three indices. The indices result in very different performance rankings of schools. While schools generally see consistent results between two of the index scores, scores on the third index are often unrelated or inversely related to the other two indices. Although the conceptual distinctions can be explained, communicating results to educators is challenging when ranking of schools is inconsistent across the indices. Empirical evidence of these inconsistencies can be seen in the correlations between index scores.

This study used data from the South Carolina Department of Education on public elementary schools (grades 3–5), middle schools (grades 6–8), and high schools (grades 9–12) for 2012/13 to determine whether the measures that make up each of the three indices of school performance in South Carolina can be used to create an overall, reliable alternative index of school performance. The alternative index was then used to identify which schools' performance scores on the alternative index are better than expected (that is, which schools are beating the odds) after school demographic characteristics are controlled for. The study also sought to identify distinct school demographic profiles among South Carolina schools and to ascertain which profiles include schools that are beating the odds.

The study found that the measures that make up the three indices currently used in South Carolina to rate schools can be combined into an overall, reliable alternative index of school performance using a bi-factor model. The alternative school performance index identified approximately 3 percent of elementary schools, 2 percent of middle schools, and 3 percent of high schools as statistically exceeding their expected performance after the schools' demographic characteristics were accounted for.

The study also found five distinct demographic profiles at the elementary school level, four at the middle school level, and three at the high school level. Most of the profiles included at least one school that was beating the odds.

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Why this study?

Administrators from the South Carolina Department of Education partnered with Regional Educational Laboratory Southeast to test the extent to which the state's three indices of school performance could be consolidated into an overall, reliable alternative index that can be used under the state's Elementary and Secondary Education Act (ESEA) waiver. The waiver allows the state to use one index to meet state and federal school accountability requirements. The department has noted that school performance ratings under the current indices result in very different rankings of schools. The state's goal is to leverage the existing indices to develop an overall, reliable index. In addition, the department was interested in using the alternative index to identify high-performing schools after school demographic characteristics are accounted for (that is, schools that are "beating the odds").

The South Carolina Department of Education has noted that ratings under the state's three indices of school performance result in very different rankings of schools. The state's goal is to leverage the indices to develop an overall, reliable index

At the time of this report's publication, South Carolina rated school performance using three indices:

- ***Absolute performance index.*** At the elementary school (grades 3–5) and middle school (grades 6–8) levels absolute performance is measured by the number of students who meet a given performance level on the state assessment, the Palmetto Assessment of State Standards, which covers English language arts, math, science, and social science. At the high school (grades 9–12) level absolute performance is measured by a combination of annual student performance on statewide end-of-course exams and other exit exams, as well as by four-year and five-year graduation rates.
- ***ESEA performance index.*** At all school levels ESEA performance is based on the percentage of student subgroups that meet the annual proficiency target on certain measures, such as statewide assessments in English language arts, math, science, and social science and graduation rates. For a given measure there are up to 10 demographic subgroups (male students, female students, White students, Black students, Asian/Pacific Islander students, Hispanic students, American Indian/Alaskan students, disabled students, limited English proficient students, and students eligible for free or reduced-price lunch[1]) in addition to the group of all students. Typically one or more subgroups are excluded because of small numbers of students.
- ***Growth performance index.*** At the elementary and middle school levels growth performance is determined using a value table developed by the South Carolina Department of Education. The measure generates a student growth score based on a student's prior year and current year scores on each of four statewide assessments (reading, math, science, and social science). At the high school level growth performance is based on the difference between the school's current year and prior year's absolute performance. As such, growth performance at the high school level is a cross-cohort comparison instead of a within-cohort comparison, as at the elementary and middle school levels.

Table 1 describes the measures that make up each index by school level, and appendix A provides details on how the indices are calculated. All the indices are derived using a point system.

Using three indices to evaluate school performance can be confusing to educators and other stakeholders. Although the conceptual distinctions can be explained, communicating results to educators is challenging when ranking of schools is inconsistent across the

Table 1. Description of South Carolina school performance indices, 2012/13

Index	Elementary and middle schools (grades 3–8)	High schools (grades 9–12)
Absolute performance index	Based on the number of students who meet a given performance level on state assessments. Performance by subject area is used to create a subject area index score, which is then used to create the overall absolute performance index score. The subject area index scores are writing and English language arts combined, math, science, and social science.	Based on the percentage of students who pass state assessments and graduate on time or in five years. The individual measures are the longitudinal (spring) High School Assessment Program passage rate, the first attempt High School Assessment Program passage rate, the end-of-course exam overall passage rate, the four-year cohort graduation rate, and the five-year graduation rate.
Elementary and Secondary Education Act performance index	Based on the percentage of subgroups that meet the target for a state assessment and the percentage tested. The individual measures are English language arts weighted points (points earned multiplied by the specified weight), math weighted points, science weighted points, social science weighted points, English language arts percentage tested weighted points,[a] and math percentage tested weighted points.	Based on the percentage of subgroups that meet the target for a state assessment, the percentage tested, and the graduation rate. The individual measures are English language arts weighted points, math weighted points, science weighted points, social science weighted points, graduation rate weighted points,[b] English language arts percentage tested weighted points,[a] and math percentage tested weighted points.
Growth performance index	Based on the amount of student growth between the student's prior year and current year scores on state assessments in English language arts, math, science, and social science.	Based on the change in the school's absolute performance index rating from the prior year to the current year.

a. The percentage tested at the school, which is used in the calculation of the Elementary and Secondary Education Act performance index score, is not used in this study because preliminary analyses revealed both measures to be highly skewed due to the fact that most schools met the target.

b. Although graduation rate weighted points is a measure in the Elementary and Secondary Education Act performance index, it was used in this study as a measure of the absolute performance factor in the high school factor models along with the other graduation rate measures. This change in structure was made due to the high correlations between the graduation rate measures.

Source: South Carolina Education Oversight Committee, 2011.

Using three indices to evaluate school performance can be confusing to educators and other stakeholders. Although the conceptual distinctions can be explained, communicating results to educators is challenging when ranking of schools is inconsistent across the indices

indices. While schools generally see consistent results between their absolute and ESEA performance index scores, their growth performance index scores are often unrelated or inversely related to the other two indices (which may be due in part to whether the growth performance index score is calculated as a within- or cross-cohort comparison). Empirical evidence of these inconsistencies can be seen in the correlations between index scores.

The correlation between the growth and ESEA performance indices is near 0 and not significant at all school levels (–.03 at the elementary school level, .06 at the middle school level, and –.08 at the high school level; see tables B2–B4 in appendix B). The correlation between the growth and absolute performance indices is significant but weak (–.20 at the elementary school level, –.13 at the middle school level, and .20 at the high school level). The correlation between the absolute and ESEA indices is significant and ranges from .72 (at the high school level) to .76 (at the elementary and middle school levels), which suggests that high scores on one index do not perfectly align to high scores on the other.

Correlations can be useful when explaining why schools' performance ratings vary. The square of a correlation coefficient is the amount of variance in one measure explained

by the other. For the absolute and ESEA performance indices, the .72–.76 correlations translate into a variance of .52–.58. This means that 52 percent of the reasons why schools differ on the absolute performance index can be explained when schools' ESEA performance index scores are known. The implication is that the South Carolina Department of Education can understand some of the reasons why schools vary on the absolute performance index (based on the ESEA performance index) but that 48 percent of the reasons why schools differ is unaccounted for. The growth performance index in elementary school may explain 4 percent of the reasons why schools differ in the absolute performance index (that is, –.20^2), but this represents a very small amount.

Several methods exist to combine scores from the measures that make up the three existing indices to an overall index of school performance, such as taking their mean or summing them. While using simple mathematical operations is appealing for practical reasons, several challenges to their use exist. For example, the indices are on different scales, which could cause some indices to have greater influence in the calculation of the overall index. Also, in a simple additive model, strengths on one index may mask weaknesses on another index unless a weighting system is applied. This study uses an alternative approach called confirmatory factor analysis to evaluate how an overall score might be created (see box 1 for definitions of key terms in the report).

Several methods exist to combine scores from the measures that make up the three existing indices to an overall index of school performance. This study uses an approach called confirmatory factor analysis

To meet the needs of the South Carolina Department of Education, this study addresses three research questions:

- Can the measures that make up each of the three indices of school performance in South Carolina be combined into an overall, reliable alternative index of school performance?

Box 1. Key terms

Beating the odd schools. Schools whose performance scores are better than expected, after school demographic characteristics are controlled for. These schools can be identified by comparing their school performance score with their expected performance based on their demographic characteristics (race/ethnicity, gender, disability status, and economic status).

Confirmatory factor analysis. A statistical model used to estimate the relationship between observed measures (for example, scores on several different reading tests) and an unobserved construct (for example, school quality) that is believed to underlie the observed measures. The unobserved construct is called a factor or latent variable when it is estimated using two or more observed measures.

Goodness of fit. The relationship between observed data and what is predicted by a specified model. The relationship can be tested by a set of different goodness-of-fit indices. Index values that fall into an accepted range are viewed as evidence of a strong relationship between the observed data and what is predicted by the model. Subsequently, the model is deemed to demonstrate "good fit."

Latent variable. The underlying construct (for example, school quality) that the observed variables are expected to measure. Latent variables are unobserved and cannot be measured directly and therefore can only be estimated statistically based on available data.

- Which schools have observed school performance scores on the new index that are better than expected (that is, beating the odds) after school demographic characteristics are controlled for?
- Can South Carolina schools be categorized by their demographic profiles, based on their predominant student demographic characteristics, and can the demographic profiles of schools that are beating the odds be identified?

In addition to the confirmatory factor analysis discussed above, which is used to answer the first two research questions, the study uses latent profile analysis to identify the demographic profiles of South Carolina schools and to determine which profiles include high-performing schools (the third research question).

The study uses data provided by the South Carolina Department of Education on each elementary, middle, and high school in the state for 2012/13, including total number of students; number of students who are White, Black, and Hispanic; number of male and female students; number of disabled students; poverty index (South Carolina's measure of school poverty); and results for each of the three school performance indices and for the measures that make up the indices. The data used in the study are also available on the South Carolina Department of Education website as a component of school report cards. See appendix A for details on South Carolina's current school performance indices and appendix B for details on the analyses.

The study uses latent profile analysis to identify the demographic profiles of South Carolina schools and to determine which profiles include high-performing schools

What the study found

This section describes the results of the analyses used to derive an alternative school performance index, identify high-performing schools relative to observable similar schools (that is, beating the odds schools), and describe the demographic characteristics of those schools.

The three school performance indices currently used in South Carolina to rate schools can be combined into an overall, reliable alternative index of school performance using a bi-factor model

This study compares four confirmatory factor analysis models at the elementary, middle, and high school levels to test different specifications of whether a singular construct (in this case, an overall, reliable index of school performance) exists based on the available data (in this case, the measures from existing school performance indices in South Carolina).

At the elementary and middle school levels, the first model is a one-factor model that hypothesizes that only one school performance construct exists and can be measured by all the status and growth measures currently used by the South Carolina Department of Education at each school level (see figure B1 in appendix B). The second model is a two-factor model that tests the possibility that there are two distinct, yet related, constructs—one (annual school performance) that can be indicated by multiple status measures and one (growth performance) that can be indicated by one or more growth measures (see figure B2 in appendix B). The third model is a three-factor model that tests the possibility that there are three distinct but related constructs; the constructs in this model are consistent with the three indices currently used by the South Carolina Department of Education (that is, absolute performance, ESEA subgroup performance, and growth performance) except that the weights for each measure differ from those used by the department (see figure B3 in appendix B). The fourth model is a bi-factor model that theorizes that absolute

performance, ESEA subgroup performance, and growth performance each exist as specific constructs but that an additional, general construct of school performance exists that captures something in common across all of the measures (see figure B4 in appendix B).

The four models tested at the high school level differed slightly from the models tested at the elementary and middle school levels because there is only one growth measure at the high school level. The one-factor model shares the same structure as the elementary and middle school models (see figure B5 in appendix B); the other models omit a separate growth performance factor and substitute an observed measure. Therefore, the second model is also a one-factor model, but it tests whether there is a distinct construct (annual school performance) that is separate but related to the growth measure (see figure B6 in appendix B). The third model is a two-factor model that tests the possibility that there are two distinct but related constructs that are also related to the growth measure (see figure B7 in appendix B). The fourth model is a bi-factor model that tests the addition of a general construct of school performance that captures what is common across all the measures (see figure B8 in appendix B).

The school performance general factor effectively combines all the observed measures into one index that can be used to evaluate school performance; its reliability was estimated at .89 at the elementary school level, .90 at the middle school level, and .95 at the high school level

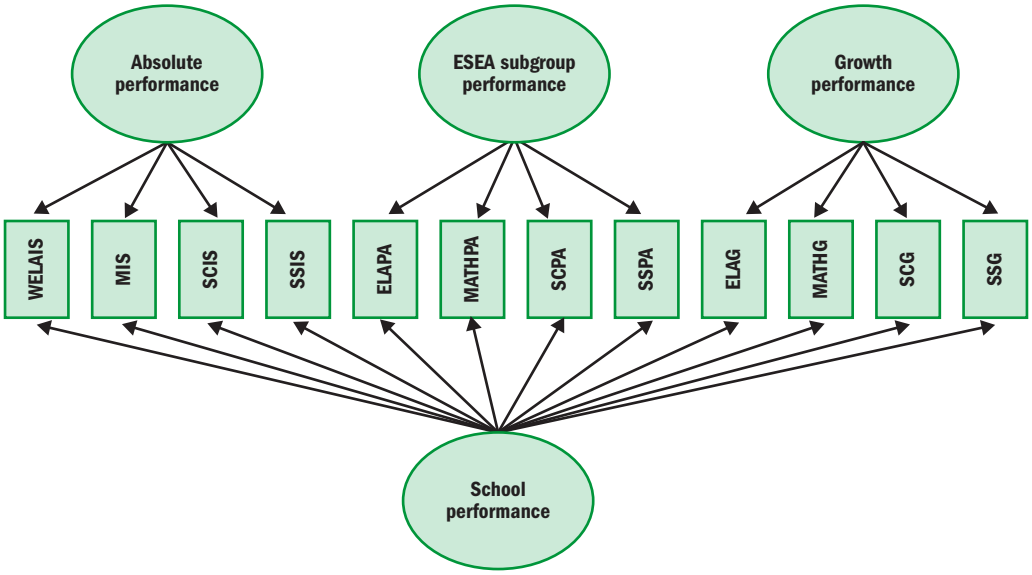
Testing these four models at each level allowed the study team to determine whether having one construct or multiple constructs best characterizes the data. An advantage of the bi-factor model is that it allowed the study team to account for the possibility of multiple constructs while providing an overall score from the general factor that could be used as the global index. Other key differences between confirmatory factor analysis models are noted in box B1 in appendix B.

The four confirmatory factor analysis models were compared using different goodness-of-fit indices to determine which one best explained the relationship among the observed measures (Rindskopf & Rose, 1988). Across all school levels the bi-factor model was found to provide the best fit to the data (see table B8 in appendix B for summary of fit indices). Figure 1 presents the bi-factor model used at the elementary and middle school levels, and figure 2 presents the bi-factor model used at the high school level.

While the bi-factor model results in up to four separate factor scores (depending on the model)—representing the constructs of absolute performance, ESEA performance, growth performance, and school performance—the interest of this study lies in the common variance explained by the school performance general factor. At the elementary and middle school levels the school performance general factor explains much of the common variance between the measures that represent absolute and ESEA performance but little of the variance in the growth measures (see table B9 in appendix B). A similar pattern exists at the high school level (see table B10 in appendix B), based on the single observed growth measure. This result suggests that the common variance found in the growth measures is not explained by the school performance general factor.

Despite the limitations of the growth measures, the school performance general factor effectively combines all the observed measures into one index that can be used to evaluate school performance and is thus used in subsequent statistical analysis as an outcome of school performance for the analysis in the next section. The reliability of the school performance general factor was estimated at .89 at the elementary school level, .90 at the middle school level, and .95 at the high school level (see appendix B for details on computation). Reliability of at least .80 is considered acceptable for research purposes, and values of at least .90 are appropriate for clinical decisionmaking.

Figure 1. Sample South Carolina bi-factor model specification at the elementary and middle school levels

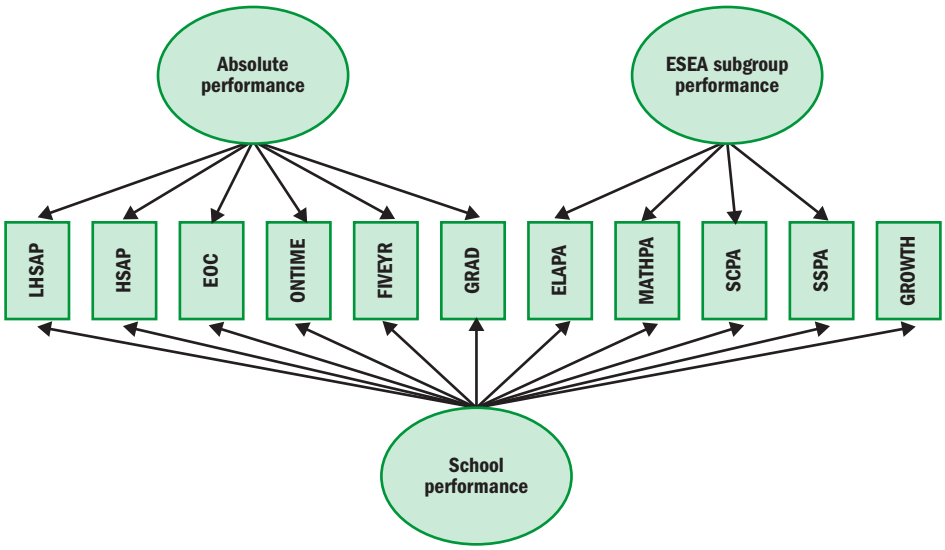


ESEA is Elementary and Secondary Education Act, WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school refers to grades 3–5, and middle school refers to grades 6–8.

Source: Authors' illustration.

Figure 2. Sample South Carolina bi-factor model specification at the high school level



ESEA is Elementary and Secondary Education Act, LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, and GROWTH is change in absolute performance index from prior year.

Note: High school refers to grades 9–12.

Source: Authors' illustration.

The good fit of the bi-factor model and the high reliability of the school performance general factor mean that all the measures used in the three existing indices can be combined into an overall, reliable alternative index of school performance.

Under the alternative index of school performance, about 3 percent of elementary schools, 2 percent of middle schools, and 3 percent of high schools beat the odds, given the schools' demographic characteristics

Schools beating the odds can be identified by comparing their score on the school performance general factor with how they would be expected to perform based on their demographic characteristics (that is, race/ethnicity, gender, disability status, and economic status). A school's expected performance can be predicted after the relationship between a school's performance factor score and a set of variables (in this case demographic characteristics) has been determined using an accepted statistical approach (see appendix B).

Schools beating the odds can be identified by comparing their score on the school performance general factor with how they would be expected to perform based on their demographic characteristics. Positive differences between observed and expected scores indicate better than expected performance

The school performance general factor scores were calculated on a scale that has a mean of 0 and a standard deviation of 1. Thus, schools with a school performance general factor score of 0 are considered average, schools with positive school performance general factor scores are considered above average, and schools with negative school performance general factor scores are considered below average.

Positive differences between observed and expected scores indicate better than expected performance. In 2012/13 the difference (called a residual) between the observed and expected school performance general factor score ranged from –1.60 to 1.78 at the elementary school level (residual standard error of ±.53), from –1.88 to 1.60 at the middle school level (residual standard error of ±.54), and from –1.89 to 1.77 at the high school level (residual standard error of ±.49).

Of the 304 elementary schools with a positive residual, 18 (about 3 percent of elementary schools statewide) had a difference large enough to be considered reliable (see appendix B for a discussion of the 95 percent confidence interval). These 18 schools beat the odds in school performance during the 2012/13 school year, with higher school performance than would be predicted after the demographic characteristics of their students were controlled for; the residuals of these schools ranged from 1.05 to 1.78. Of the 146 middle schools with a positive residual, 6 (about 2 percent) were identified as high performing relative to their expected school performance general factor scores after the schools' demographic characteristics were controlled for. The residuals of these schools ranged from 1.03 to 1.60. Of the 105 high schools with a positive residual, 6 (about 3 percent) were identified as high performing, with residuals that ranged from .96 to 1.77.

The number of school demographic profiles identified by latent profile analysis differs by school level, and most profiles contained at least one school that was beating the odds

To determine the extent to which high-performing schools were demographically similar to other schools in South Carolina, the study team used latent profile analysis—which allows for the identification of subgroups within multivariate data and is a special case of cluster analysis—to identify distinct school demographic profiles in the state. Based on the average demographic characteristics of each profile, schools with similar demographics can be matched in a "nearest neighbor" approach. For example, a school with a lower than

expected school performance general factor score might be paired with a school within the same profile that has a higher than expected school performance general factor score (that is, a school beating the odds). Such a pairing would allow for successful schools to mentor struggling schools with similar demographic characteristics.

Each profile is named for its predominant student demographic characteristic or characteristics, with the term "high" used when the percentage of students in the category was above the state average and exceeded 70 percent. References to the state "average" (that is, below, above, or at the average) are used to further distinguish the profile from other profiles and are generally qualitative judgments.

Elementary schools. Five distinct demographic profiles were identified at the elementary school level (table 2):

- Profile 1: High percentage of White students and average poverty index (35 percent of schools).
- Profile 2: High percentage of White students and below average poverty index (13 percent of schools).
- Profile 3: General population (22 percent of schools). This profile reflects the approximate state averages for all characteristics.
- Profile 4: High poverty index and above average percentage of Hispanic students (10 percent of schools).
- Profile 5. High percentage of Black students and high poverty index (20 percent of schools).

Five distinct demographic profiles were identified at the elementary school level; each profile included at least one of the 18 elementary schools identified by the alternate index of school performance as beating the odds

Table 2. Five demographic profiles of South Carolina public elementary schools, 2012/13 (mean percentages, unless otherwise noted)

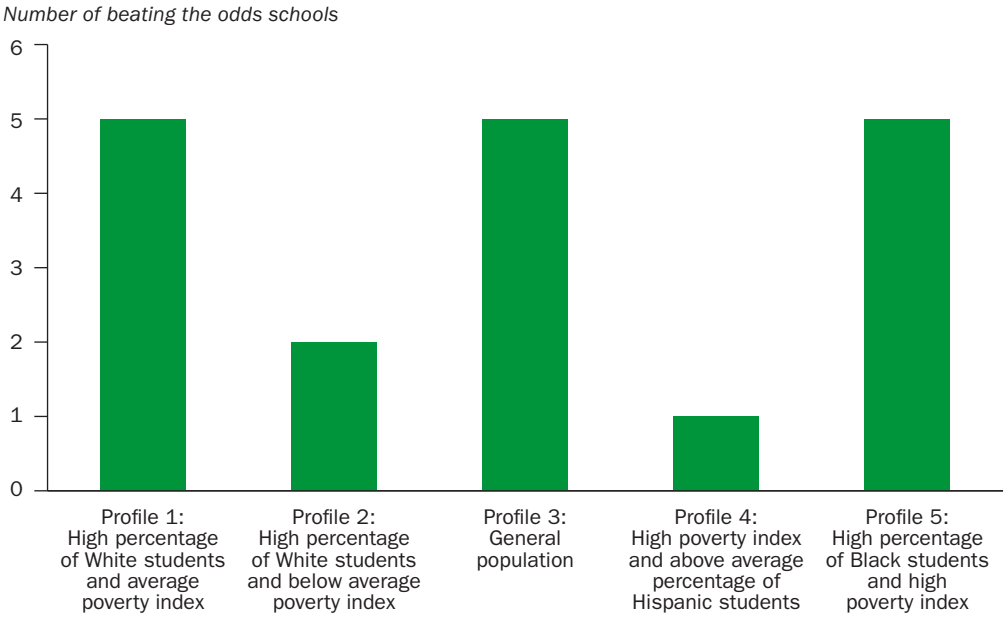
Demographic characteristic	State profile	Profile 1: High percentage of White students and average poverty index	Profile 2: High percentage of White students and below average poverty index	Profile 3: General population	Profile 4: High poverty index and above average percentage of Hispanic students	Profile 5: High percentage of Black students and high poverty index
White	49.27	70.73	75.15	41.74	36.20	9.50
Black	41.10	20.03	15.99	48.60	38.00	85.89
Hispanic	6.93	6.26	4.51	5.74	23.64	2.97
Male	51.45	51.45	51.20	51.59	51.77	51.31
Disabled	12.57	12.75	10.07	13.65	12.37	12.81
Income status						
Mean poverty index	75.29	70.96	36.64	82.35	84.55	95.62
Number and percentage of schools						
Number	619	215	81	139	62	122
Percent	na	35	13	22	10	20
School performance						
Mean school performance index	0.04	0.40	1.35	–0.19	–.37	–1.01

na is not applicable.

Note: Elementary school refers to grades 3–5.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Figure 3. All five demographic profiles of elementary schools in South Carolina included at least one school that was beating the odds based on its rating under the alternative school performance index, 2012/13



Note: *n* = 18. Elementary school refers to grades 3–5.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Four distinct demographic profiles were identified at the middle school level; three profiles included at least one of the six middle schools identified by the alternative index of school performance as beating the odds

Each profile included at least one of the 18 elementary schools identified in the previous section as beating the odds (figure 3). Profiles 1, 3, and 5 each had five schools that were beating the odds; profiles 2 and 4 had fewer. It is unsurprising that the schools beating the odds are fairly evenly distributed across the different profiles because the individual school residuals used to identify schools as beating the odds are uncorrelated with the demographic characteristics of each school.

Middle schools. Four distinct demographic profiles were identified at the middle school level (table 3):

- Profile 1: High percentage of White students and below average poverty index (12 percent of schools).
- Profile 2: High percentage of Black students and high poverty index (23 percent of schools).
- Profile 3: High poverty index and above average percentage of Hispanic students (10 percent of schools).
- Profile 4: General population (55 percent of schools). This profile reflects the approximate state averages for all characteristics.

Profiles 1, 2, and 4 included at least one of the six middle schools identified in the previous section as beating the odds; profile 3 did not (figure 4).

High schools. Three distinct demographic profiles were identified at the high school level (table 4):

- Profile 1: High percentage of White students and below average poverty index (11 percent of schools).

Table 3. Four demographic profiles of South Carolina public middle schools, 2012/13 (mean percentages, unless otherwise noted)

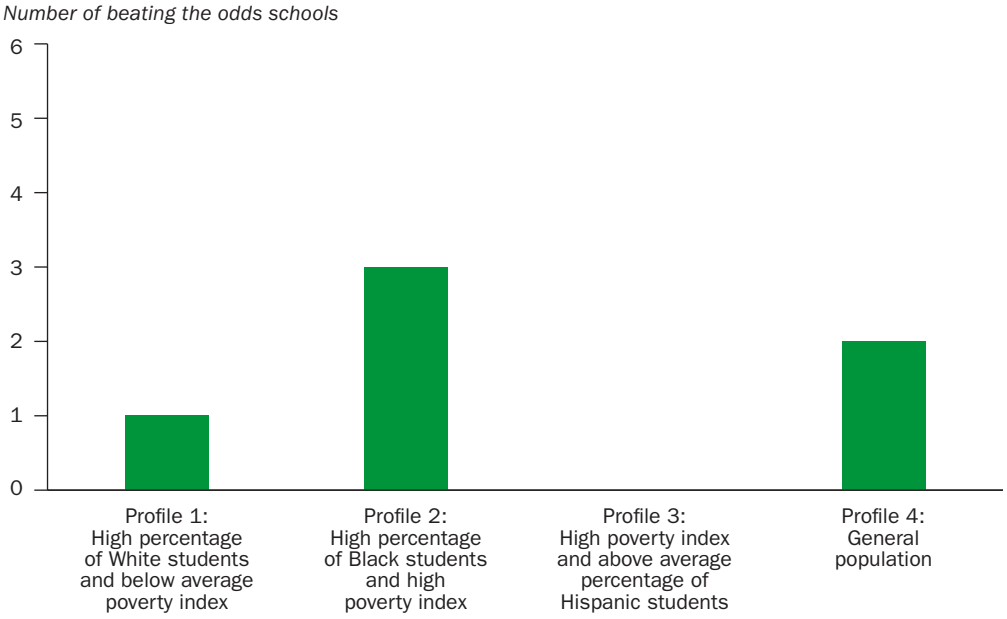
Demographic characteristic	State profile	Profile 1: High percentage of White students and below average poverty index	Profile 2: High percentage of Black students and high poverty index	Profile 3: High poverty index and above average percentage of Hispanic students	Profile 4: General population
White	50.62	75.08	13.71	43.15	62.15
Black	42.02	16.68	81.61	40.99	30.47
Hispanic	4.64	4.27	2.20	12.86	4.22
Male	51.03	49.53	50.83	51.64	51.34
Disabled	12.93	7.68	15.35	13.14	13.01
Income status					
Mean poverty index	73.66	35.70	93.86	79.67	72.20
Number and percentage of schools					
Number	286	35	66	29	156
Percent	na	12	23	10	55
School performance					
Mean school performance index	0.02	1.47	–.91	–0.15	0.12

na is not applicable.

Note: Middle school refers to grades 6–8.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Figure 4. Demographic profiles 1, 2, and 4 of middle schools in South Carolina included at least one school that was beating the odds under the alternative school performance index, 2012/13



Note: *n* = 6. Middle school refers to grades 6–8.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table 4. Three demographic profiles of South Carolina public high schools, 2012/13 (mean percentages, unless otherwise noted)

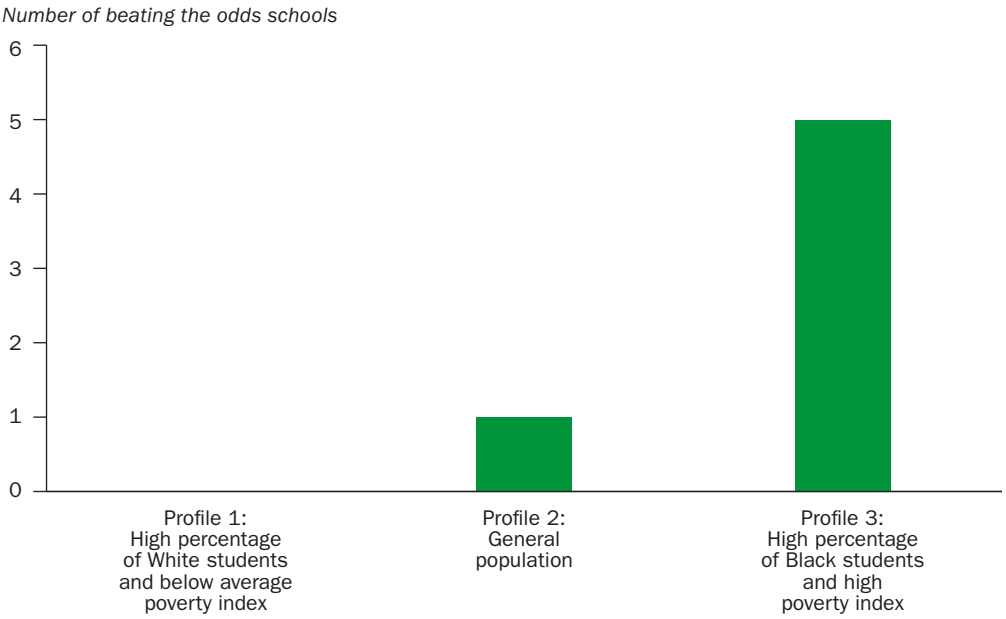
Demographic characteristic	State profile	Profile 1: High percentage of White students and below average poverty index	Profile 2: General population	Profile 3: High percentage of Black students and high poverty index
White	50.75	74.24	60.71	14.44
Black	42.79	17.52	31.88	80.61
Hispanic	4.16	5.05	4.58	2.74
Male	50.83	50.07	51.01	50.76
Disabled	12.20	7.90	12.01	14.63
Income status				
Mean poverty index	69.88	35.25	67.71	91.13
Number and percentage of schools				
Number	201	23	128	50
Percent	na	11	64	25
School performance				
Mean school performance index	0.06	1.17	0.27	–0.96

na is not applicable.

Note: High school refers to grades 9–12.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Figure 5. Demographic profiles 2 and 3 of high schools in South Carolina included at least one school that was beating the odds under the alternative school performance index, 2012/13



Note: *n* = 6. High school refers to grades 9–12.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

- Profile 2: General population (64 percent of schools). This profile reflects approximate state averages for all characteristics.
- Profile 3: High percentage of Black students and high poverty index (25 percent of schools).

Three distinct demographic profiles were identified at the high school level; two profiles included at least one of the six high schools identified by the alternate index of school performance as beating the odds

Profiles 2 and 3 included at least one of the six high schools identified in the previous section as beating the odds; profile 1 did not (figure 5).

Implications, limitations, and next steps

This study demonstrates that South Carolina could combine the existing three indices of school performance into one index, thereby reducing the burden on parents and the public in interpreting three indices with inconsistent rankings. Beyond its use in a school accountability framework, the combined index could also be used in South Carolina to identify schools that are beating the odds. In addition, the study results could inform decisions related to the development of new accountability indices in other states with similar models.

Several limitations of the study should be considered. First, the analyses were conducted using school-level data instead of student-level data. Using student-level data would permit a more rigorous evaluation by allowing for the modeling of hierarchical data (that is, students within classes within schools) and the characteristics of individual students. Additionally, the school performance estimates and ranking of schools depend on the schools included in the analysis. While outliers were removed, there may be schools in the sample that serve a specialized student population based on specified enrollment criteria (for example, a charter school serving high-performing students or a school whose population consists primarily of students with disabilities). Such schools have historically demonstrated higher or lower performance on statewide assessments, and thus including those schools may affect which schools are ultimately identified as high performing. Future work should include a sensitivity analysis to evaluate how the school performance estimates change as particular schools are excluded, as well as which schools may be differentially identified as high performing.

In addition, the measures that are currently used by the South Carolina Department of Education to indicate growth could be studied further. While the bi-factor model provided the best fit to the data, the common variance found in the growth measures was not explained by the school performance general factor. This means that the growth measures, for the most part, are not contributing to the estimation of the school performance general factor. This is especially true at the high school level, where there is only one measure of growth. As explained in appendix A, the measure of growth at the high school level is the difference between the current year and prior year's absolute performance index at the school. This difference measure could be studied further to better understand its contribution to explaining school performance in South Carolina.

Finally, only one year of school performance data was used in the analyses. Although the current results provide preliminary support for the use of a global school performance index, it is important to test the invariance of the study findings over several years. By using the factor loadings, residual variances, and error covariances in this study, the South Carolina Department of Education could both replicate the analyses reported here and extend the model to test for how well the approach replicates over time.

Appendix A. South Carolina's current school performance indices

South Carolina rates school performance using three indices: an absolute performance index, an index developed to comply with the Elementary and Secondary Education Act (ESEA), and a growth performance index. Each index is described in detail below.

Absolute performance index

Elementary and middle schools. All schools serving grades 3–8 receive an absolute performance index rating. Each school's rating is based on the number of students who meet a given performance level on the state assessment, the Palmetto Assessment of State Standards (PASS), which covers reading and research (referred to as English language arts), writing, math, social studies, and science. PASS scores are reported on a within-grade scale of 300–900, and the scale score needed to meet grade-level performance standards is 600 (South Carolina Department of Education, 2014b).

In addition to the PASS, some students in grades 6–8 also have scores on end-of-course exams in algebra I, English I, and physical science, which are typically taken in high school. The scores on these assessments are included in the rating of the school where the student is enrolled. This means that the elementary school ratings include five subjects, but the middle school ratings can include up to eight, depending on whether the student has taken one or more end-of-course exams. End-of-course exam scores are reported on a scale of 0–100 (South Carolina Department of Education, 2014c).

The state has designated five proficiency levels for the PASS, and each proficiency level is worth between one and five points on the absolute performance index. All the subject area tests use the same proficiency categories and assign the same point values to each level, though the cutpoints for each proficiency category vary by grade level and subject area. In addition, schools earn points based on the scores of students on all three possible end-of-course exams.

The absolute performance index ratings for elementary and middle schools (grades 3–8) are calculated in four steps:

1. Calculate the average points per subject per school by multiplying the points assigned to each PASS proficiency level or end-of-course exam score (table A1) and dividing by the total number of tests. For grades with a writing test, the English language arts index is a composite of the PASS English language arts (67 percent) and the PASS writing (33 percent).

2. Weight each subject area based on state statute by multiplying the subject area indices by the approved weight (table A2).[2] These weighted values serve as the observed measures used in the confirmatory factor analysis detailed in appendix B.

3. Sum the unrounded weighted values to create an index score that is then rounded to the nearest hundredth (see table A3 for an example of this step).

4. Assign the final absolute performance index rating using the approved scale (table A4). (For the hypothetical school in table A3, the score of 3.14 would earn an "average" absolute rating.)

Table A1. Rating points received for each Palmetto Assessment of State Standards proficiency level and end-of-course grade at the elementary and middle school levels under South Carolina's absolute performance index, 2012/13

Palmetto Assessment of State Standards proficiency level	End-of-course grade	Rating points
Exemplary 5	A	5
Exemplary 4	B	4
Met	C	3
Not met 2	D	2
Not met 1	F	1

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: South Carolina Education Oversight Committee, 2011.

Table A2. Subject area weights at the elementary and middle school levels under South Carolina's absolute performance index, 2012/13

School level	English language arts	Math	Science	Social studies
Elementary (grades 3–5)	0.30	0.30	0.20	0.20
Middle (grades 6–8)	0.25	0.25	0.25	0.25

Source: South Carolina Education Oversight Committee, 2011.

Table A3. Example rating calculation for an elementary school under South Carolina's absolute performance index, 2012/13

Palmetto Assessment of State Standards (PASS) proficiency level or calculation component	English language arts	Math	Science	Social studies	Rating index
PASS proficiency level					
Exemplary 5	26	22	14	18	na
Exemplary 4	35	37	25	28	na
Met	56	64	28	33	na
Not met 2	43	32	23	14	na
Not met 1	15	11	14	8	na
Calculation component					
Total points	539	525	314	337	na
Total tests	175	166	104	101	na
Index	3.08	3.16	3.02	3.34	na
Weight	0.3	0.3	0.2	0.2	na
Weighted value	0.92	0.95	0.60	0.67	3.14

na is not applicable.

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: Authors' illustration based on points and weights outlined in tables A1 and A2.

Table A4. Rating scale under South Carolina's absolute performance index, 2012/13

Score	Rating
3.40 or higher	Excellent
3.18–3.39	Good
2.65–3.17	Average
2.32–2.64	Below average
2.31 or lower	At risk

Source: South Carolina Education Oversight Committee, 2011.

High schools. Calculating ratings at the high school (grades 9–12) level involves the same steps as the elementary and middle school level but uses different measures. Instead of using PASS and end-of-course exam scores, the high school ratings are based on:

- Longitudinal (spring) High School Assessment Program passage rate.
- First attempt High School Assessment Program passage rate.
- End-of-course exam overall passage rate.
- On-time graduation rate.
- Five-year graduation rate.

Each criterion is assigned a point value ranging from 1–5 based on the school's score (table A5).

The high school ratings aggregate student data to the school level before assigning points. Essentially the school receives points according to table A5 for the percentage of students who pass or graduate. These points are multiplied by the weight for that criterion (table A6) and then summed. The conversion from score to rating in table A4 is also used for high schools.

Elementary and Secondary Education Act performance index

South Carolina was awarded an ESEA waiver that allows the state to implement its own accountability system. The state developed a model that awards up to one point for each subgroup that meets the target for a certain measure, such as a state assessment or other outcome. The targets, or annual measurable objectives, are described in table A7.

Table A5. Cutpoints for high school ratings under South Carolina's absolute performance index, 2012/13 (percent)

Criterion	1 point	2 points	3 points	4 points	5 points
Longitudinal (spring) High School Assessment Program passage rate	75.8 or lower	75.9–84.0	84.1–94.2	94.3–96.9	97.0 or higher
First attempt High School Assessment Program passage rate	53.1 or lower	53.2–63.0	63.1–82.9	83.0–92.9	93.0 or higher
End-of-course exam overall passage rate	30.7 or lower	30.8–41.9	42.0–64.2	64.3–75.4	75.5 or higher
On-time graduation rate	47.3 or lower	47.4–59.5	59.6–83.9	84.0–96.0	96.1 or higher
Five-year graduation rate	50.2 or lower	50.3–62.6	62.7–87.6	87.7–96.9	97.0 or higher

Note: High school refers to grades 9–12.

Source: South Carolina Education Oversight Committee, 2011.

Table A6. Subject area weights under South Carolina's high school absolute performance index, 2012/13

Criterion	Weight
Longitudinal (spring) High School Assessment Program passage rate	.20
First attempt High School Assessment Program passage rate	.20
End-of-course exam overall passage rate	.20
On-time graduation rate	.30
Five-year graduation rate	.10

Source: South Carolina Education Oversight Committee, 2011.

Table A7. Targets under South Carolina's Elementary and Secondary Education Act performance index, by school level, 2012/13

Measure	Elementary schools (grades 3–5)	Middle schools (grades 6–8)	High schools (grades 9–12)
English language arts proficiency	Mean PASS score of 635	Mean PASS score of 628	Mean High School Assessment Program score of 226
Math proficiency	Mean PASS score of 635	Mean PASS score of 628	Mean High School Assessment Program score of 223
Science proficiency	Mean PASS score of 635	Mean PASS score of 628	Mean end-of-course exam score of 77
Social studies and history proficiency	Mean PASS score of 635	Mean PASS score of 628	Mean end-of-course exam score of 73
Percentage of students tested in English language arts	95	95	95
Percentage of students tested in math	95	95	95
Met or improved graduation rate	na	na	74.1

PASS is Palmetto Assessment of State Standards.

na is not applicable.

Note: The High School Assessment Program scores range from 100 to 320 (South Carolina Department of Education, 2014d).

Source: South Carolina Department of Education, 2013.

For a given outcome there are up to 10 demographic subgroups (male students, female students, White students, Black students, Asian/Pacific Islander students, Hispanic students, American Indian/Alaskan students, disabled students, limited English proficient students, and students eligible for free or reduced-price lunch[3]) in addition to the all students group; typically one or more are excluded because of small numbers of students. The specific measures and their weighted values are shown in table A8.

A school's rating is calculated in three steps:

1. Sum the total points on the measure earned by all the available subgroups.

2. Divide the total points by the number of available subgroups to generate the percentage of subgroups meeting the target.

Table A8. Weights under South Carolina's Elementary and Secondary Education Act performance index, by school level, 2012/13

Measure	Elementary and middle schools (grades 3–8)	High schools (grades 9–12)
English language arts proficiency	.35	.225
Math proficiency	.35	.225
Science proficiency	.05	.05
Social studies and history proficiency	.05	.05
Percentage of students tested in English language arts	.10	.075
Percentage of students tested in math	.10	.075
Met or improved graduation rate	na	.30

na is not applicable.

Source: South Carolina Department of Education, 2013.

3. Multiply the percentages by the weights in table A8 and sum the total points. This produces an index score between 0 and 100, which is used to assign a letter grade from A to F, where 90–100 is an A, 80–89.9 is a B, and so forth. The individual subject area components serve as the observed measures used in the confirmatory factor analysis detailed in appendix B.

Growth performance index

Elementary schools. The growth performance index rating at the elementary and middle school levels is based on value tables and student-level growth within cohorts. A value table assigns a point value based on the change between a student's prior and current year scores on the PASS (table A9). For example, a student who scored "not met 1" in one year and "not met 2" in the next year would earn 100 points, and a student who scored "met" in one year and "exemplary 4" in the next year would earn 110 points.

A hypothetical distribution for an elementary school is shown in table A10.

Table A11 shows the points earned for school X based on the number of points received for each combination of prior and current year PASS scores (see table A9) multiplied by the number of students who achieved each combination (see table A10). The average score for school X's 382 students is 95.92, which resolves to a rating of "average" (table A12).

Table A9. Value table for calculating ratings for elementary and middle schools under South Carolina's growth performance index, 2012/13

Prior year Palmetto Assessment of State Standards proficiency level	Current year Palmetto Assessment of State Standards proficiency level				
	Not met 1	Not met 2	Met	Exemplary 4	Exemplary 5
Exemplary 5	40	60	80	90	100
Exemplary 4	50	70	90	100	110
Met	60	80	100	110	120
Not met 2	70	90	110	120	130
Not met 1	80	100	120	130	140

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: South Carolina Education Oversight Committee, 2011.

Table A10. Hypothetical elementary school distribution of prior and current year Palmetto Assessment of State Standards proficiency levels: School X

Prior year Palmetto Assessment of State Standards proficiency level	Current year Palmetto Assessment of State Standards proficiency level					Total number of students
	Not met 1	Not met 2	Met	Exemplary 4	Exemplary 5	
Exemplary 5	0	4	15	22	21	62
Exemplary 4	1	4	22	26	17	70
Met	8	26	38	24	15	111
Not met 2	15	28	20	11	1	75
Not met 1	27	17	14	6	0	64

Note: *n* = 382.

Source: Authors' illustration.

Table A11. School X value table result

Prior year Palmetto Assessment of State Standards proficiency level	Current year Palmetto Assessment of State Standards proficiency level					Total points for each proficiency level in prior year
	Not met 1	Not met 2	Met	Exemplary 4	Exemplary 5	
Exemplary 5	0	240	1,200	1,980	2,100	5,520
Exemplary 4	50	280	1,980	2,600	1,870	6,780
Met	480	2,080	3,800	2,640	1,800	10,800
Not met 2	1,050	2,520	2,200	1,320	130	7,220
Not met 1	2,160	1,700	1,680	780	0	6,320
Total points across all combinations of proficiency levels	na	na	na	na	na	36,640
Average (*n* = 382)	na	na	na	na	na	95.92

na is not applicable.

Source: Authors' illustration based on values and distribution of proficiency levels outlines in tables A9 and A10.

Table A12. Rating cutpoints for elementary and middle schools (grades 3–8) under South Carolina's growth performance index, 2012/13

Index score	Rating
98.48 or higher	Excellent
96.39–98.47	Good
92.20–96.38	Average
90.11–92.19	Below average
90.10 or lower	At risk

Source: South Carolina Education Oversight Committee, 2011.

High schools. The approach to calculating the rating at the high school level under the growth performance index is greatly simplified from the approach used at the elementary and middle school levels. The high school rating is simply the change in the school's absolute rating from the prior year to the current year. This means the growth is based on the difference in the absolute score from two different cohorts of students (that is, cross-cohort growth). The cutpoints are noted in table A13.

Table A13. Rating cutpoints for high schools under South Carolina's growth performance index, 2012/13

Index score	Rating
0.4 or greater	Excellent
0.3	Good
0.1–0.2	Average
0.0	Below average
–0.1 or less	At risk

Note: High school covers grades 9–12.

Source: South Carolina Education Oversight Committee, 2011.

Appendix B. Details on the analyses and results

This study entailed a multistage analysis designed to develop an understanding of South Carolina's current methodology for rating schools and explore the creation of an alternative composite index that can also be used to identify schools beating the odds. In addition, it conducted analyses to identify distinct school profiles in order to allow matching of schools with similar demographic characteristics. This appendix details how the analyses were conducted and provides results that supplement the findings in the main text.

Preliminary analyses

The study team first calculated means and standard deviations for the three current rating indices (absolute performance, Elementary and Secondary Education Act [ESEA] performance, and growth performance; table B1), correlations between the current indices (tables B2–B4), and means and standard deviations for the individual measures that make up the indices as well as correlations between them (tables B5–B7). The correlation between the absolute and ESEA performance indices is high, ranging from .72 at the high school level to .76 at the elementary and middle school levels. The correlation between the growth performance index and the other two indices is low or nonsignificant at all levels. The

Table B1. Means and standard deviations for three South Carolina school ratings indices, by school level, 2012/13

Index and statistics	Elementary schools (grades 3–5)	Middle schools (grades 6–8)	High schools (grades 9–12)
Absolute performance index			
Mean	3.18	3.05	3.38
Standard deviation	.43	.46	.66
Elementary and Secondary Education Act performance index			
Mean	82.82	77.52	73.00
Standard deviation	17.40	19.08	17.74
Growth performance index			
Mean	100.65	101.01	.10
Standard deviation	1.61	1.23	.30

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B2. Correlations between South Carolina rating indices at the elementary school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index
Absolute performance index	1		
Elementary and Secondary Education Act performance index	.76**	1	
Growth performance index	–.20**	–.03	1

** Significant at the 0.01 level (two-tailed).

Note: Elementary school covers grades 3–5.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B3. Correlations between South Carolina rating indices at the middle school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index
Absolute performance index	1		
Elementary and Secondary Education Act performance index	.76**	1	
Growth performance index	–.13*	.06	1

* Significant at the 0.05 level (two-tailed); ** significant at the 0.01 level (two-tailed).

Note: Middle school covers grades 6–8.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B4. Correlations between South Carolina rating indices at the high school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index
Absolute performance index	1		
Elementary and Secondary Education Act performance index	.72**	1	
Growth performance index	.20**	–.08	1

** Significant at the 0.01 level (two-tailed).

Note: High school covers grades 9–12.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

same pattern exists in the relationships between the growth measures and the measures of the other two indices.

Creating an overall, reliable alternative index of school performance using the measures that make up the three existing indices of school performance in South Carolina

The purpose of research question 1 was to explore an alternative rating method that would allow South Carolina to create an overall school performance rating with existing measures instead of using three different indices as it does now.

Confirmatory factor analysis (Muthén & Muthén, 2012) was used to identify the measurement model that best explained the covariances among the observed measures. Four traditional factor models were specified and differed slightly by school level: a unidimensional model of school performance indicated by all the observed school performance measures; a two-factor model with correlated constructs of annual performance and growth performance; a three-factor model with correlated constructs of absolute performance, growth performance, and ESEA subgroup performance; and a bi-factor model with individual constructs of absolute performance, growth performance, and ESEA subgroup performance, as well as a school performance general factor that was indicated by all the variables (figures B1–B8). While the two- and three-factor models were estimated for comparison purposes,

Table B5. Correlations between and means and standard deviations for South Carolina rating index measures at the elementary school level, 2012/13

Measure	WELAIS	MIS	SCIS	SSIS	ELAPA	MATHPA	SCPA	SSPA	ELAG	MATHG	SCG	SSG
WELAIS	1											
MIS	.93**											
SCIS	.92**	.92**	1									
SSIS	.90**	.88**	.92**	1								
ELAPA	.55**	.52**	.50**	.49**	1							
MATHPA	.66**	.76**	.66**	.62**	.54**	1						
SCPA	.59**	.58**	.66**	.57**	.29**	.45**	1					
SSPA	.61**	.62**	.60**	.70**	.45**	.61**	.50**	1				
ELAG	–.17**	–.17**	–.19**	–.19**	–.03	–.06	.00	–.06	1			
MATHG	–.12**	–.07	–.17**	–.17**	–.04	.07	.01	–.04	.63**	1		
SCG	–.11**	–.08*	–.03	–.08	–.01	.01	.21**	.05	.40**	.40**	1	
SSG	–.06	–.04	–.06	.03	.03	.03	.09*	.20**	.39**	.39**	.36**	1
N	649	649	649	649	645	645	645	645	639	639	634	636
Mean	3.37	3.18	2.89	3.21	31.65	25.57	2.07	3.60	99.25	101.00	101.52	102.07
Standard deviation	0.41	0.48	0.41	0.51	6.25	11.20	1.70	1.52	2.67	3.03	2.31	2.84

* Significant at the 0.05 level (two-tailed); ** significant at the 0.01 level (two-tailed).

WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school covers grades 3–5.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B6. Correlations between and means and standard deviations for South Carolina rating index measures at the middle school level, 2012/13

Measure	WELAIS	MIS	SCIS	SSIS	ELAPA	MATHPA	SCPA	SSPA	ELAG	MATHG	SCG	SSG
WELAIS	1											
MIS	.93**	1										
SCIS	.90**	.88**	1									
SSIS	.90**	.85**	.91**	1								
ELAPA	.62**	.58**	.56**	.58**	1							
MATHPA	.66**	.74**	.63**	.63**	.68**	1						
SCPA	.66**	.64**	.76**	.71**	.49**	.56**	1					
SSPA	.65**	.61**	.66**	.76**	.57**	.55**	.66**	1				
ELAG	–.28**	–.28**	–.31**	–.24**	.02	–.13*	–.17**	–.16**	1			
MATHG	.02	.09	.00	.07	.07	.24**	.10	.05	.45**	1		
SCG	–.27**	–.24**	–.09	–.16**	.02	–.05	.16**	–.04	.27**	.29**	1	
SSG	.01	.00	.03	.12*	.09	.05	.02	.25**	.36**	.24**	.15**	1
N	304	304	304	304	301	301	301	301	304	304	304	304
Mean	3.15	2.97	2.95	3.14	27.82	24.47	2.38	2.92	100.60	99.50	102.20	101.74
Standard deviation	0.43	0.51	0.45	0.53	7.96	10.49	1.66	1.64	1.43	1.78	2.17	2.01

* Significant at the 0.05 level (two-tailed); ** significant at the 0.01 level (two-tailed).

WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Middle school covers grades 6–8.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B7. Correlations between and means and standard deviations for South Carolina rating index measures at the high school level, 2012/13

Measure	LHSAP	HSAP	EOC	ONTIME	FIVEYR	ELAPA	MATHPA	SCPA	SSPA	GRAD	GROWTH
LHSAP	1										
HSAP	.66**	1									
EOC	.57**	.84**	1								
ONTIME	.74**	.55**	.44**	1							
FIVEYR	.73**	.61**	.47**	.91**	1						
ELAPA	.46**	.70**	.58**	.27**	.27**	1					
MATHPA	.46**	.80**	.63**	.30**	.33**	.76**	1				
SCPA	.29**	.57**	.57**	.13	.12	.49**	.57**	1			
SSPA	.41**	.50**	.64**	.31**	.28**	.32**	.34**	.31**	1		
GRAD	.39**	.33**	.22**	.48**	.61**	.22**	.27**	.15*	.13	1	
GROWTH	.20**	.11	.07	.12	.01	–.04	.00	–.07	.00	–.18*	1
N	209	209	209	209	209	198	198	198	198	198	202
Mean	90.41	78.98	67.44	77.53	78.82	17.81	15.63	3.54	1.40	20.30	0.10
Standard deviation	11.24	11.89	15.03	13.48	13.59	5.77	6.93	1.44	1.45	8.09	0.30

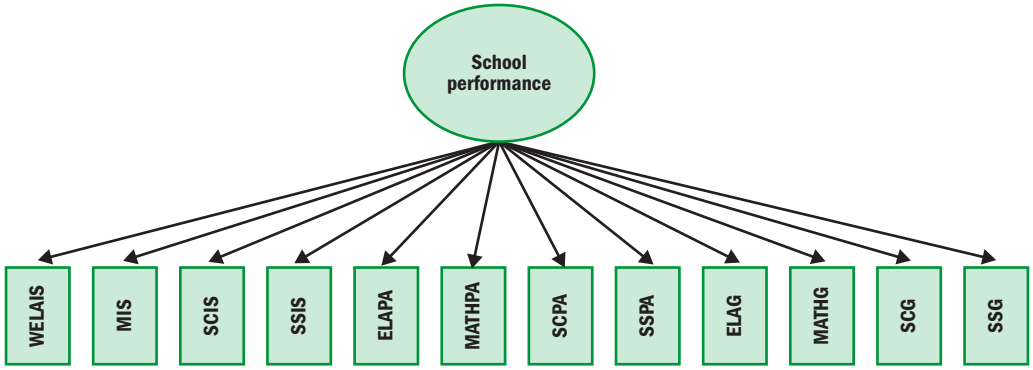
* Significant at the 0.05 level (two-tailed); ** significant at the 0.01 level (two-tailed).

LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, GRAD is graduation rate weighted points, and GROWTH is change in absolute performance index from prior year.

Note: High school covers grades 9–12.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Figure B1. Sample South Carolina factor model specifications at the elementary and middle school levels: One-factor model

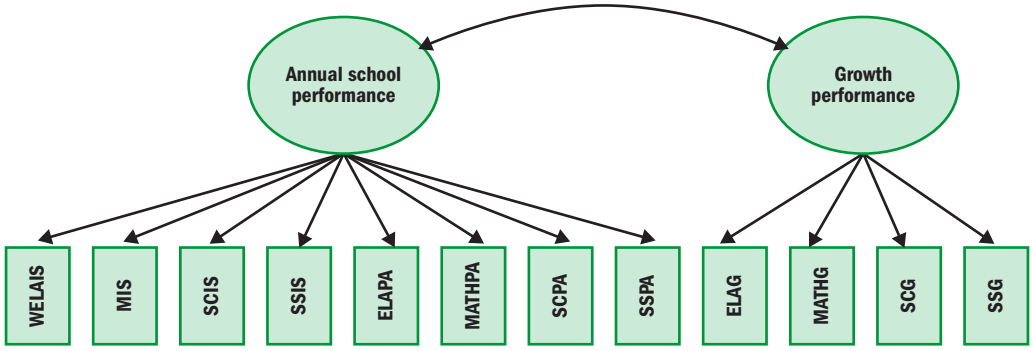


WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: Authors' illustration.

Figure B2. Sample South Carolina factor model specifications at the elementary and middle school levels: Two-factor model

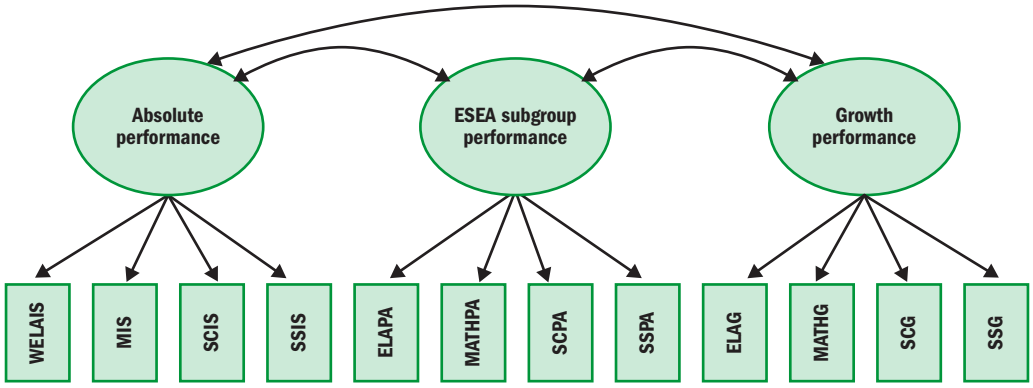


WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: Authors' illustration.

Figure B3. Sample South Carolina factor model specifications at the elementary and middle school levels: Three-factor model

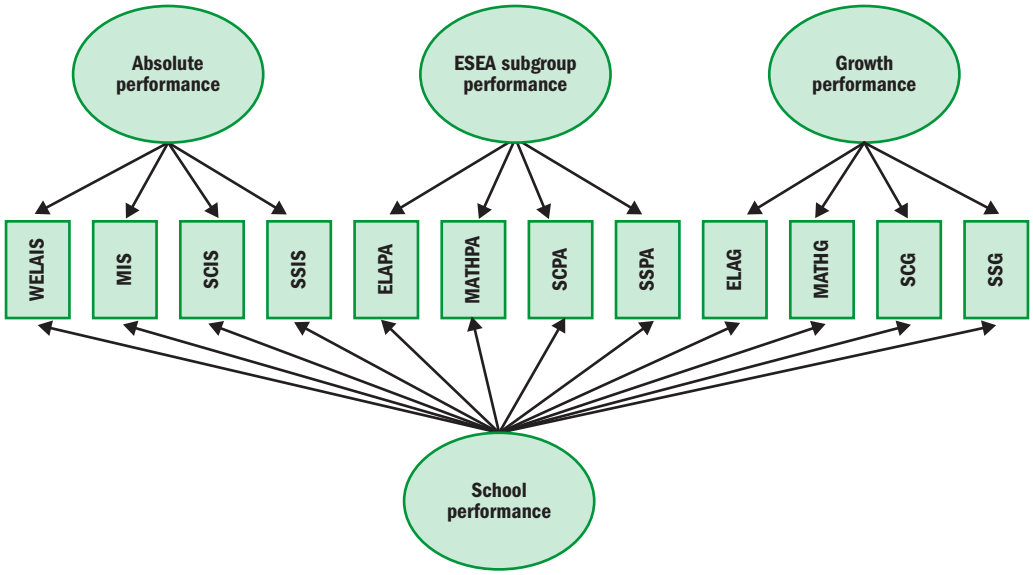


ESEA is Elementary and Secondary Education Act, WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: Authors' illustration.

Figure B4. Sample South Carolina factor model specifications at the elementary and middle school levels: Bi-factor model

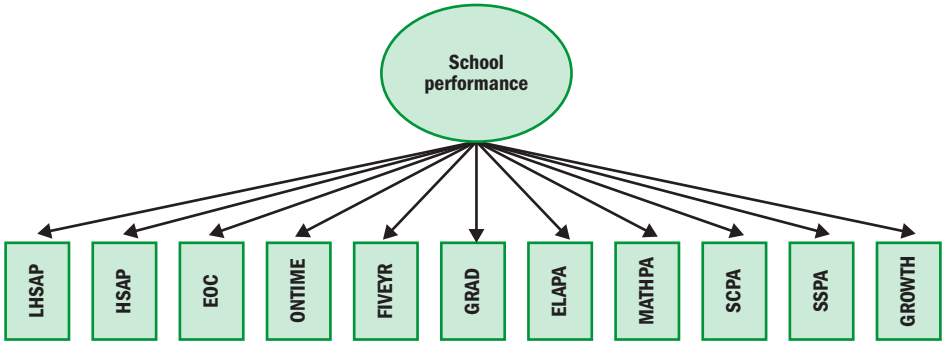


ESEA is Elementary and Secondary Education Act, WELAIS is writing and English language arts combined index score, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

Note: Elementary school covers grades 3–5, and middle school covers grades 6–8.

Source: Authors' illustration.

Figure B5. Sample South Carolina factor model specifications at the high school level: One-factor model 1

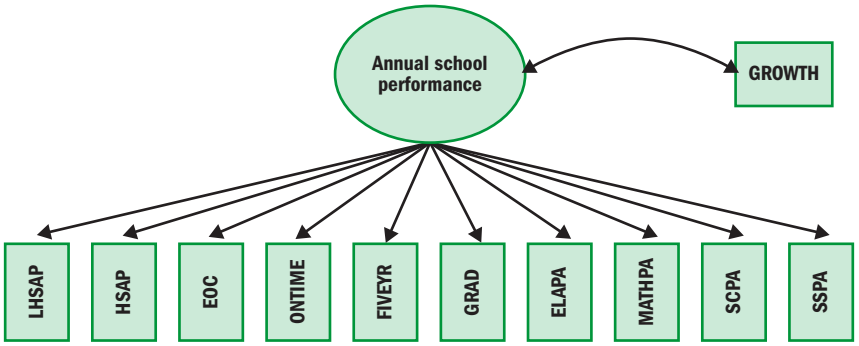


LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, and GROWTH is change in absolute performance index from prior year.

Note: High school covers grades 9–12.

Source: Authors' illustration.

Figure B6. Sample South Carolina factor model specifications at the high school level: One-factor model 2

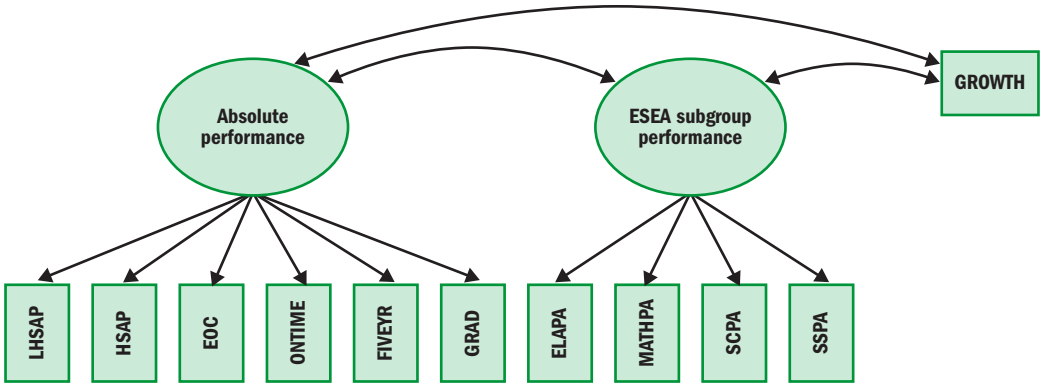


GROWTH is change in absolute performance index from prior year, LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, and SSPA is social science weighted points.

Note: High school covers grades 9–12.

Source: Authors' illustration.

Figure B7. Sample South Carolina factor model specifications at the high school level: Two-factor model

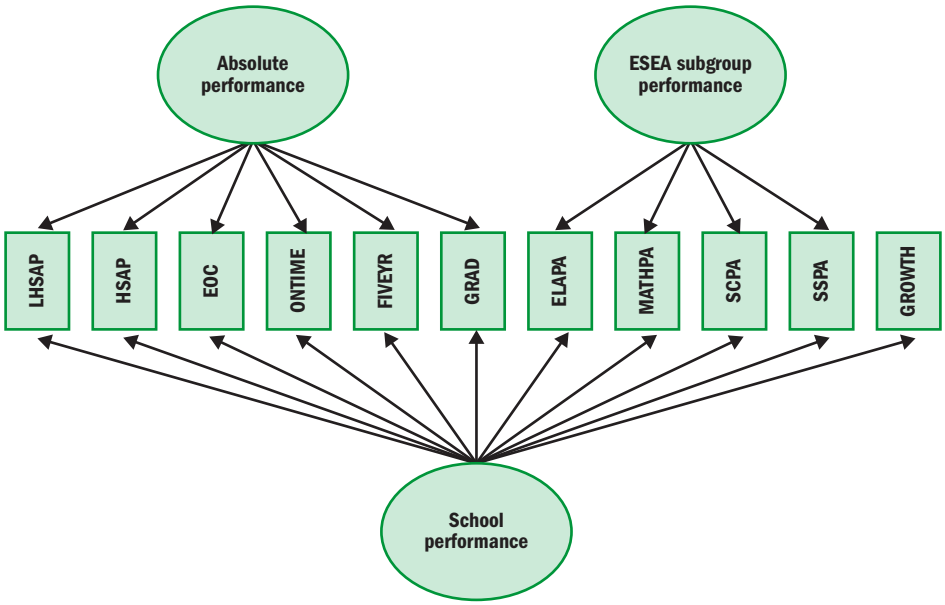


ESEA is Elementary and Secondary Education Act, GROWTH is change in absolute performance index from prior year, LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, and SSPA is social science weighted points.

Note: High school covers grades 9–12.

Source: Authors' illustration.

Figure B8. Sample South Carolina factor model specifications at the high school level: Bi-factor model



ESEA is Elementary and Secondary Education Act, LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, and GROWTH is change in absolute performance index from prior year.

Note: High school covers grades 9–12.

Source: Authors' illustration.

only the unidimensional model and the bi-factor model generated a precision weighted factor score that could be used to characterize school performance.

Within the confirmatory factor analysis framework, two alternative models represent a hierarchical factor structure: higher order models (also known as second-order models) and bi-factor models. Higher order models have been applied in a variety of substantive areas, whereas bi-factor models have been used almost exclusively in personality research. Murray and Johnson (2013) found that both higher order and bi-factor models yield relatively stable estimates of general construct scores. Higher order models assume that the effects of the general construct are mediated by lower order constructs, while bi-factor models assume that the associations between the general construct and the measures are direct and independent of the specific constructs (Murray & Johnson, 2013). In bi-factor models the general construct explains the covariance shared by all the measures. The specific constructs account for the covariance independent of the general construct. The general construct and the specific constructs are uncorrelated and account for the covariance simultaneously and independently for each measure. The idea of bi-factor models is to look at how much of the total covariance is explained by the specific constructs compared with that explained by the general construct (Deng, Wells, & Hambleton, 2008).

The weak correlations between the growth performance index and the other two indices support the assumption that specific constructs are independent of the general construct. Higher order models are more suitable when lower order factors are sufficiently correlated

with each other, but bi-factor models are applicable to situations when not all the constructs are correlated.

Other key differences between competing confirmatory factor analysis models are summarized in box B1.

The loadings and residuals for each factor model were examined for statistical significance and reasonability, as well as the reliability of the measures and fit of the estimated model using multiple indices:

- Ratio between the chi-square and degrees of freedom (χ^2/df; Byrne, 1989; < 3.0 desired).
- Akaike information criteria (AIC; Kaplan, 2000: smaller values desired).
- Bayesian information criterion (BIC; Kaplan, 2000; smaller values desired).
- Root mean square error of approximation (RMSEA; Browne & Cudeck, 1992; ≤ .05 desired).
- Comparative fit index (CFI; Bentler, 1990; ≥ .95 desired).
- Tucker-Lewis index (TLI; Bentler & Bonnett, 1980; ≥ .95 desired).
- Standardized root square mean residual (SRMR; Hu & Bentler, 1998; ≤ .05 desired).

Box B1. Key differences between confirmatory factor analysis models

One-factor model

- Advantage: A single underlying factor (for example, school quality) accounts for the variance in all the individual measures.
- Disadvantage: The model does not account for relationships between specific factors (for example, absolute performance and Elementary and Secondary Education Act performance).

Multiple correlated factors model

- Advantage: The model explicitly accounts for relationships between specific factors.
- Disadvantage: The model does not account for the effects of a single underlying factor (for example, school quality).

Higher order factor model

- Advantage: The model includes the effects of both specific factors (for example, absolute performance) and a general factor (for example, school quality).
- Disadvantages: The higher order factor (for example, school quality) does not have a direct relationship with (or effect on) individual measures. In addition, the general factor and specific factors are not easily included in a prediction equation.

Bi-factor model

- Advantages: The model represents simultaneous effects of both specific factors and a general latent factor on the individual measures and provides purer estimates of specific factors than can be obtained from a higher order factor model.
- Disadvantage: In practice, the general factor is uncorrelated with the specific factors, which could misrepresent the data.

The bi-factor model provided the best fit to the data at all school levels (table B8). For example, the bi-factor and the next best fitting model at the elementary level (the three-factor model) differed by ΔAIC = 69 and ΔBIC = 59 in favor of the bi-factor model ($\chi^2(33) = 74.23$, RMSEA = .04 [90 percent confidence interval = .03, .06], CFI = .99, TLI = .98). To contextualize the differences in BIC values, Raftery (1995) reported that information criteria differences of greater than 10 provide evidence for large, practically important differences. Murray and Johnson (2013) recommend differences in BIC values higher than 10, which is demonstrated with differences ranging from 46 to 95.

Reliability for the school performance general factor was estimated as:

$$\text{Reliability of school performance general factor} = \frac{(\sum_{i=1}^{n}\lambda_i)^2}{(\sum_{i=1}^{n}\lambda_i)^2 + (\sum_{i=1}^{n}\delta_i)} \quad ,$$

where λ_i is the standardized factor loading for measure i and δ_i is the error variance for measure i. The standardized estimates and residual variances in tables B9 and B10 were used in this equation to estimate reliability (Raykov, 1997).

Factor scores were estimated for the population of schools with a mean set at 0 and a standard deviation set at 1 so that school performance general factor scores were on a *z*-score metric. The factor score determinacies for the school performance general factor were found to be very high (.99 at the elementary and middle school levels and .98 at the high

Table B8. Comparison of model fit indices by school level, 2012/13

Model	Chi-square	Degrees of freedom	*p* value	Akaike information criteria	Adjusted Bayesian information criteria	Root mean square error of approximation			Comparative fit index	Tucker-Lewis index	Standardized root mean square residual
							90 percent confidence interval				
							Lower bound	Upper bound			
Elementary schools (grades 3–5)											
One factor	487.26	42	0.00	23,801	23,863	0.13	0.12	0.14	0.88	0.82	0.25
Two factor	228.34	42	0.00	23,239	23,301	0.08	0.07	0.09	0.95	0.92	0.09
Three factor	128.90	41	0.00	23,085	23,149	0.06	0.05	0.07	0.98	0.96	0.05
Bi-factor	74.23	33	0.00	23,016	23,090	0.04	0.03	0.06	0.99	0.98	0.07
Middle schools (grades 6–8)											
One factor	253.72	42	0.00	10,509	10,535	0.13	0.11	0.14	0.87	0.79	0.10
Two factor	201.80	43	0.00	10,420	10,445	0.11	0.10	0.13	0.90	0.85	0.11
Three factor	135.53	42	0.00	10,303	10,330	0.09	0.07	0.10	0.94	0.91	0.13
Bi-factor	102.84	33	0.00	10,253	10,284	0.08	0.07	0.10	0.96	0.91	0.09
High schools (grades 9–12)											
One factor 1[a]	144.54	40	0.00	12,419	12,426	0.11	0.09	0.13	0.89	0.85	0.10
One factor 2[a]	144.54	40	0.00	12,419	12,426	0.11	0.09	0.13	0.89	0.85	0.10
Two factor	140.27	38	0.00	12,406	12,413	0.11	0.09	0.13	0.90	0.85	0.10
Bi-factor	92.25	34	0.00	12,311	12,318	0.09	0.07	0.11	0.94	0.90	0.07

a. The model fit does not change between the one-factor models at the high school level because there is only one measure of growth at the high school level. Growth at the high school level is calculated as the difference between the current and prior year absolute performance index score.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B9. Standardized factor loadings, residual covariances, and residual variances for the bi-factor models at the elementary and middle school levels, 2012/13

Measure	Elementary schools (grades 3–5)			Middle schools (grades 6–8)		
	Standardized estimate	Standard error	*p* value	Standardized estimate	Standard error	*p* value
Absolute performance by						
WELAIS	–0.08	0.03	0.02	0.29	0.10	0.01
MIS	–0.03	0.03	0.43	0.33	0.14	0.02
SCIS	–0.14	0.03	0.00	0.16	0.10	0.11
SSIS	–0.44	0.04	0.00	–0.09	0.22	0.68
Elementary and Secondary Education Act performance by						
ELAPA	0.32	0.05	0.00	0.52	0.08	0.00
MATHPA	0.51	0.07	0.00	0.49	0.07	0.00
SCPA	0.06	0.05	0.21	0.18	0.08	0.03
SSPA	0.33	0.06	0.00	0.21	0.08	0.01
Growth performance by						
ELAG	0.78	0.05	0.00	0.71	0.08	0.00
MATHG	0.76	0.04	0.00	0.65	0.08	0.00
SCG	0.56	0.11	0.00	0.39	0.16	0.02
SSG	0.59	0.11	0.00	0.46	0.09	0.00
School performance by						
WELAIS	0.96	0.01	0.00	0.93	0.04	0.00
MIS	0.96	0.01	0.00	0.90	0.05	0.00
SCIS	0.95	0.01	0.00	0.93	0.02	0.00
SSIS	0.90	0.02	0.00	0.99	0.02	0.00
ELAPA	0.53	0.03	0.00	0.62	0.04	0.00
MATHPA	0.70	0.02	0.00	0.66	0.03	0.00
SCPA	0.61	0.03	0.00	0.71	0.05	0.00
SSPA	0.62	0.03	0.00	0.76	0.04	0.00
ELAG	–0.18	0.04	0.00	–0.26	0.06	0.00
MATHG	–0.15	0.04	0.00	0.05	0.06	0.36
SCG	–0.10	0.05	0.04	–0.19	0.10	0.07
SSG	–0.06	0.05	0.22	0.09	0.07	0.18
Residual covariances						
MATHPA with MIS	0.67	0.10	0.00	0.65	0.12	0.00
SSPA with SSIS	[a]	[a]	[a]	[b]	[b]	[b]
ELPA with WELAIS	0.18	0.05	0.00	0.23	0.10	0.02
SCPA with SCIS	0.37	0.04	0.00	0.42	0.07	0.00
MATHG with MIS	0.41	0.06	0.00	0.37	0.14	0.01
MATHG with MATHPA	0.41	0.08	0.00	0.37	0.09	0.00
SCG with SCIS	0.30	0.05	0.00	0.44	0.09	0.00
SCG with SCPA	0.30	0.04	0.00	0.37	0.08	0.00
SSG with SSIS	[a]	[a]	[a]	[b]	[b]	[b]
SSG with SSPA	0.43	0.08	0.00	0.35	0.07	0.00
ELAG with ELAPA	[b]	[b]	[b]	0.31	0.087	0.00

(continued)

Table B9. Standardized factor loadings, residual covariances, and residual variances for the bi-factor models at the elementary and middle school levels, 2012/13 *(continued)*

Measure	Elementary schools (grades 3–5)			Middle schools (grades 6–8)		
	Standardized estimate	Standard error	*p* value	Standardized estimate	Standard error	*p* value
Residual variances						
WELAIS	0.08	0.01	0.00	0.05	0.02	0.01
MIS	0.07	0.01	0.00	0.09	0.02	0.00
SCIS	0.08	0.01	0.00	0.12	0.02	0.00
SSIS	0.00	[a]	[a]	0.01	0.08	0.90
ELAPA	0.62	0.05	0.00	0.35	0.08	0.00
MATHPA	0.25	0.07	0.00	0.33	0.06	0.00
SCPA	0.63	0.03	0.00	0.46	0.06	0.00
SSPA	0.51	0.06	0.00	0.38	0.05	0.00
ELAG	0.36	0.07	0.00	0.42	0.10	0.00
MATHG	0.41	0.06	0.00	0.58	0.10	0.00
SCG	0.67	0.12	0.00	0.81	0.10	0.00
SSG	0.65	0.12	0.00	0.78	0.09	0.00

WELAIS is Index score for writing and English language arts combined, MIS is math index score, SCIS is science index score, SSIS is social science index score, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, ELAG is English language arts growth index, MATHG is math growth index, SCG is science growth index, and SSG is social science growth index.

a. Not estimated because elementary residual variance for SSIS was set to 0.

b. Removed from the model specification to improve fit because error covariances were nonsignificant.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B10. Standardized factor loadings and residual variances for the bi-factor model at the high school level, 2012/13

Measure	Standardized estimate	Standard error	*p* value
Absolute performance by			
LHSAP	0.46	0.12	0.00
HSAP	0.12	0.07	0.11
EOC	–0.01	0.08	0.93
ONTIME	0.77	0.07	0.00
FIVEYR	0.84	0.07	0.00
GRAD	0.56	0.07	0.00
Elementary and Secondary Education Act performance by			
ELAPA	0.32	0.07	0.00
MATHPA	0.43	0.11	0.00
SCPA	0.12	0.08	0.15
SSPA	–0.29	0.11	0.01
School performance by			
LHSAP	0.64	0.06	0.00
HSAP	0.95	0.02	0.00
EOC	0.88	0.02	0.00
ONTIME	0.50	0.09	0.00

(continued)

Table B10. Standardized factor loadings and residual variances for the bi-factor model at the high school level, 2012/13 *(continued)*

Measure	Standardized estimate	Standard error	*p* value
FIVEYR	0.54	0.09	0.00
GRAD	0.40	0.09	0.00
ELAPA	0.78	0.04	0.00
MATHPA	0.85	0.03	0.00
SCPA	0.68	0.05	0.00
SSPA	0.64	0.05	0.00
GROWTH	0.12	0.11	0.24
Residual variances			
LHSAP	0.38	0.09	0.00
HSAP	0.09	0.03	0.00
EOC	0.22	0.04	0.00
ONTIME	0.16	0.08	0.04
FIVEYR	0.01	0.07	0.84
GRAD	0.53	0.10	0.00
ELAPA	0.30	0.07	0.00
MATHPA	0.09	0.08	0.23
SCPA	0.52	0.06	0.00
SSPA	0.51	0.10	0.00
GROWTH	0.99	0.03	0.00

LHSAP is longitudinal (spring) High School Assessment Program passage rate, HSAP is first attempt High School Assessment Program passage rate, EOC is end-of-course exam overall passage rate, ONTIME is four-year cohort graduation rate, FIVEYR is five-year graduation rate, GRAD is graduation rate weighted points, ELAPA is English language arts weighted points, MATHPA is math weighted points, SCPA is science weighted points, SSPA is social science weighted points, GROWTH is change in absolute performance index from prior year.

Note: High school covers grades 9–12.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

school level), indicating a strong, positive correlation between the estimated score and the factor score. In other words, the school performance general factor score estimates meet validity requirements for serving as substitutes for the factor itself in subsequent statistical analyses (Grice, 2001).

Correlations between the school performance general factor scores and the existing indices were found to be strong for the absolute and ESEA performance indices (approaching unison at the elementary and middle school levels) and weak or nonsignificant for the growth performance index (tables B11–B13). This means that the school performance general factor scores maintain the same pattern that is observed in the existing indices derived with point systems.

Table B11. Correlations between the school performance general factor and existing indices at the elementary school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index	School performance general factor
Absolute performance index	1			
Elementary and Secondary Education Act performance index	.76**	1		
Growth performance index	–.20**	–.03	1	
School performance general factor	.99**	.76**	–.22**	1

** Significant at the 0.01 level (two-tailed).

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B12. Correlations between the school performance general factor and existing indices at the middle school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index	School performance general factor
Absolute performance index	1			
Elementary and Secondary Education Act performance index	.76**	1		
Growth performance index	–.13*	.06	1	
School performance general factor	.98**	.74**	–.10	1

* Significant at the 0.05 level (two-tailed); ** significant at the 0.01 level (two-tailed).

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Table B13. Correlations between the school performance general factor and existing indices at the high school level, 2012/13

Index	Absolute performance index	Elementary and Secondary Education Act performance index	Growth performance index	School performance general factor
Absolute performance index	1			
Elementary and Secondary Education Act performance index	.72**	1		
Growth performance index	.20**	–.08	1	
School performance general factor	.85**	.83**	.12	1

** Significant at the 0.01 level (two-tailed).

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

Identifying schools that are beating the odds after school demographic characteristics are controlled for

The school performance general factor score estimated by the bi-factor model was used as the outcome measure in a multiple linear regression prediction model that used school demographic characteristics as predictors:

$$Y_j = B_0 + B_1(\%White)_j + B_2(\%Black)_j + B_3(\%Hispanic)_j + B_4(\%Male)_j + B_5(Poverty)_j + B_6(\%Disabled)_j + e_j,$$

where the dependent variable Y_j is the value of the school performance general factor score for school *j*, controlling for the school's poverty index and the percentage of students who are classified as White, Black, Hispanic, male, and disabled. The school-level residual, e_j, served as the measure of a school's success in increasing school performance.

The initial elementary school dataset included 649 schools. Two cases were deleted due to missing poverty index scores. An analysis of univariate and multivariate outliers resulted in the deletion of an additional 28 cases. The final dataset included 619 schools.

The initial middle school dataset included 304 schools. Five cases were deleted due to missing poverty index scores. An analysis of univariate and multivariate outliers resulted in the deletion of an additional 13 cases. The final dataset included 286 schools.

The initial high school dataset included 209 schools. An analysis of univariate and multivariate outliers resulted in the deletion of 8 cases. The final dataset included 201 schools.

Prior to conducting the analyses, the school-level correlations among the demographic variables were examined for multicollinearity. The percentages of White and Black students were found to be negatively correlated above –0.90 at all school levels: –0.92 at the elementary school level, –0.94 at the middle school level, and –0.96 at the high school level. Variance inflation factor statistics supported the assumption that including both variables in the models would present multicollinearity issues; variance inflation factor values for White and Black students were above 10 in each school-level model.

To determine the best set of predictors for use in the models, variable selection procedures were used. At the elementary school level the adjusted R^2, Mallows's C_p statistic, and BIC methods converged on the inclusion of the following variables in the model: percentage of students who are Black, percentage of students who are Hispanic, poverty index value, and percentage of students who are disabled. This combination of variables also presented the lowest estimated mean square error of prediction. This prediction model resulted in an R^2 of .69. The effects of the independent variables on the school performance general factor score are summarized in table B14.

Using the same process, the variables selected for the middle school model were percentage of students who are Black, percentage of students who are Hispanic, poverty index value, and percentage of students who are disabled. However, the percentage of students who are disabled was not found to be a significant predictor (p = .09) so it was removed from the final model. This prediction model resulted in an R^2 of .68 (see table B14).

Table B14. Regression results summary by school level, 2012/13

Variable	Standardized estimate	*t* value	*p* value
Elementary schools (grades 3–5): $n = 619$; $R^2 = .69$			
Intercept	0.00	28.35	0.00
Percentage of students who are Black	–0.31	–9.81	0.00
Percentage of students who are Hispanic	–0.05	–2.15	0.03
Poverty index value	–0.56	–16.98	0.00
Percentage of students who are disabled	–0.09	–3.86	0.00
Middle schools (grades 6–8): $n = 286$; $R^2 = .68$			
Intercept	0.00	19.23	0.00
Percentage of students who are Black	–0.15	–3.12	0.00
Percentage of students who are Hispanic	0.08	2.26	0.02
Poverty index value	–0.71	–15.19	0.00
High schools (grades 9–12): $n = 201$; $R^2 = .70$			
Intercept	0.00	–1.57	0.12
Percentage of students who are White	0.34	6.02	0.00
Percentage of students who are male	0.17	4.12	0.00
Poverty index value	–0.42	–6.65	0.00
Percentage of students who are disabled	–0.22	–4.71	0.00

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

At the high school level the variable selection process resulted in the use of the following variables: percentage of students who are White, percentage of students who are male, poverty index value, and percentage of students who are disabled. This prediction model resulted in an R^2 of .70 (see table B14).

The model residuals were used to evaluate which schools' observed estimates were greater than expected (that is, which schools performed better than expected by having a higher school performance general factor score than expected).

Because residuals have a mean of zero, the range of residuals was important for contextualizing the differences between the observed and predicted factor scores. Additionally, the standard error of the residual—a measure of the precision of each residual estimate—provides information for identifying which schools could reliably be identified as high performers given the data. The range of the elementary school residuals was –1.60 to 1.78, with a residual standard error of .53. The range of the middle school residuals was –1.88 to 1.60, with a residual standard error of .54. The range of the high school residuals was –1.89 to 1.77, with a residual standard error of .49.

A 95 percent confidence interval was constructed around each school's residual, using the formula:

95 percent confidence interval =
School residual ± 1.96 × standard error of the school's residual.

This confidence interval allowed for the determination of whether a value of zero was just as plausible as the estimated residual. When zero is contained within a school's 95 percent confidence interval, it cannot be reliably determined that the school is high performing.

Schools were identified as high performers when the 95 percent confidence interval did not include zero.

Of the 304 elementary schools with a positive residual, 18 had a 95 percent confidence interval that did not include zero. Therefore, approximately 3 percent of elementary schools in South Carolina can be considered to be beating the odds. The residuals of these schools ranged from 1.05 to 1.78.

Of the 146 middle schools with a positive residual, 6 had a 95 percent confidence interval that did not include zero. These schools account for about 2 percent of middle schools in South Carolina. The residuals of these schools ranged from 1.03 to 1.60.

Of the 105 high schools with a positive residual, 6 had a 95 percent confidence interval that did not include zero. These schools account for about 3 percent of high schools in South Carolina. The residuals of these schools ranged from .96 to 1.77.

To illustrate, the estimated school performance general factor score for the elementary school with the greatest positive residual was .69, but its predicted score, after school demographic characteristics were controlled for, was –1.09. This means that the school performed about 1.78 standard deviations higher than expected and that 1.78 is its residual value. The 95 percent confidence interval for this school is .74 to 2.82.[4] The 95 percent confidence interval does not include zero, which indicates a significant difference between the estimated and predicted factor scores. Using this approach, it can be estimated that any elementary school with a positive residual less than 1.039 and a standard error of .53 would no longer be considered as a high performing school because its 95 percent confidence interval (calculated using residual ± 1.96 × .53) would include zero.

Identifying profiles of demographically similar schools

The next stage of the analysis featured a latent profile analysis of school demographic characteristics. This clustering of schools provides a "nearest neighbor" comparison, allowing the South Carolina Department of Education to compare the residual scores from the regression analyses with those that are most similar based on demographic characteristics. The demographic variables used in this analysis included the school's poverty index and the percentage of students who are Black, Hispanic, male, and disabled. Due to the high correlations between the percentages of students who are Black and White, the percentage of students who are White was not used in the analyses.

Latent profile analysis is typically used to classify individuals into groups based on their responses on a single exam or based on their scores on multiple exams. And though it has been used predominantly for diagnostic purposes in psychology, it is an emerging descriptive classification technique in education (Koon, Petscher, & Foorman, 2014; Logan & Petscher, 2010). While latent profile analysis is descriptive, its utility lies in its ability to empirically categorize participants (in this case, schools) into similar groups based on variables of interest (in this case, demographic characteristics). For example, if the latent profile analysis was used to identify two profiles (or groups) of schools, there would most likely be one group of schools with high percentages of students at high risk of reading difficulty and one group with low percentages. The schools with high percentages would be considered high risk, and those with low percentages would be considered low risk.

Then, within a profile, the variation in individual school outcomes can be described (for example, school residual scores).

The basic representation of a multivariate latent profile analysis model (Pastor, Barron, Miller, & Davis, 2007) is:

$$f(y_i|\theta) = \sum_{k=1}^{K} \pi_k f_k(y_i|u_k \Sigma_k),$$

where y_i represents the multivariate distribution of cluster measures (school demographics) for school i (with the number of clusters represented by k), θ represents the unique set of model parameters to be estimated within each cluster, and π_k is the weight given to each cluster. The weights are constrained to be non-negative and must sum to 1. Each cluster distribution is defined by u_k (the mean vector) and Σ_k (the covariance matrix).

Multiple indices were used to determine which number of profiles was the most appropriate for the data (table B15). The indices include Akaike information criteria (Kaplan, 2000), Bayesian information criteria (Kaplan, 2000), entropy (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993), and two tests reported in the Mplus program (Muthén & Muthén, 2012)—the Lo-Mendell-Rubin likelihood ratio test (Lo, Mendell, & Rubin, 2001) and a parametric bootstrapped likelihood ratio test (McLachlan & Peel, 2000).

A five-class model was selected as the best fit to the data at the elementary school level. Moving to six classes resulted in a nonsignificant *p*-value for the Lo-Mendell-Rubin

Table B15. Summary of latent profile analysis model fit indices by school level, 2012/13

Number of classes	Akaike information criteria	Bayesian information criteria	Adjusted Bayesian information criteria	Entropy	Lo-Mendell-Rubin adjusted likelihood ratio test		Bootstrapped likelihood ratio test (*p* value)
					Value	*p* value	
Elementary schools (grades 3–5)							
1	21,875.07	21,919.35	21,887.60	na	na	na	na
2	21,468.79	21,539.64	21,488.84	0.85	407.71	0.00	0.00
3	21,100.94	21,198.35	21,128.51	0.90	370.25	0.00	0.00
4	20,834.53	20,958.52	20,869.62	0.89	271.37	0.00	0.00
5	20,761.52	20,912.08	20,804.13	0.85	82.86	0.00	0.00
6	20,693.58	20,870.71	20,743.71	0.88	77.92	0.14	0.00
Middle schools (grades 6–8)							
1	9,976.48	10,013.04	9,981.33	na	na	na	na
2	9,766.34	9,824.84	9,774.10	0.87	215.78	0.00	0.00
3	9,602.20	9,682.63	9,612.87	0.90	171.10	0.00	0.00
4	9,531.37	9,633.74	9,544.95	0.89	80.46	0.01	0.00
5	9,478.49	9,602.79	9,494.98	0.86	63.02	0.11	0.00
High schools (grades 9–12)							
1	6,870.77	6,903.80	6,872.12	na	na	na	na
2	6,699.73	6,752.58	6,701.89	0.84	177.46	0.00	0.00
3	6,619.39	6,692.06	6,622.36	0.88	89.53	0.03	0.00
4	6,567.18	6,659.67	6,570.96	0.89	62.25	0.16	0.00

na is not applicable.

Source: Authors' analysis based on data from the South Carolina Department of Education (2014a).

likelihood ratio test. In addition to fitting the data well, the five-class model resulted in a solution that lent itself well to interpretation. Using the same criteria for selection, a four-class model was selected for the middle school level and a three-class model was selected for the high school level.

Notes

1. The South Carolina Department of Education uses the term "disabled students" to refer to students in special education and "limited English proficient students" to refer to English learner students.
2. The weighted measures for the absolute performance index differ considerably from the weighted measures used in the ESEA performance model. The absolute performance index is a weighted average of the total number of students passing a subject area test, while the ESEA performance index is based on the total number of subgroups that meet a predetermined proficiency target, with each subgroup worth up to one point.
3. The South Carolina Department of Education uses the term "disabled students" to refer to students in special education and "limited English proficient students" to refer to English learner students.
4. The 95 percent confidence interval was created using the following calculations: $1.78 - (1.96 \times .53) = .74$ and $1.78 + (1.96 \times .53) = 2.82$.

References

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238–246.

Bentler, P. M., & Bonnett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588–606.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*(2), 230–258.

Byrne, B. M. (1989). *A primer of LISREL: Basic applications and programming for confirmatory factor analytic models*. New York, NY: Springer-Verlag.

Deng, N., Wells, C., & Hambleton, R. (2008). *A confirmatory factor analytic study examining the dimensionality of educational achievement tests* (Paper No. 31). NERA Conference Proceedings. Retrieved May 4, 2015, from http://digitalcommons.uconn.edu/cgi/viewcontent.cgi?article=1031&context=nera_2008.

Grice, J. W. (2001). Computing and evaluating factor scores. *Psychological Methods*, 6(4), 430–450.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*(4), 424–453.

Kaplan, D. (2000). *Structural equation modeling: Foundations and extensions*. Thousand Oaks, CA: Sage Publications.

Koon, S., Petscher, Y., & Foorman, B. R. (2014). *Beating the odds: Finding schools exceeding achievement expectations with high-risk students* (REL 2014–032). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast. http://ies.ed.gov/ncee/edlabs

Lo, Y., Mendell, N., & Rubin, D. (2001). Testing the number of components in a normal mixture. *Biometrika, 88*, 767–778.

Logan, J. A. R., & Petscher, Y. (2010). School profiles of at-risk student concentration: Differential growth in oral reading fluency. *Journal of School Psychology, 48*(2), 163–186. http://eric.ed.gov/?id=EJ872935

McLachlan, G. J., & Peel, D. (2000). *Finite mixture models*. New York, NY: John Wiley & Sons, Inc.

Murray, A. L., & Johnson, W. (2013). The limitations of model fit in comparing the bi-factor versus higher-order models of human cognitive ability structure. *Intelligence*, *41*(5), 407–422.

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide (7th ed.)*. Los Angeles, CA: Authors.

Pastor, D. A., Barron, K. E., Miller, B. J., & Davis, S. L. (2007). A latent profile analysis of college students' achievement goal orientation. *Contemporary Educational Psychology, 32*(1), 8–47. http://eric.ed.gov/?id=EJ751860

Raftery, A. (1995). Bayesian model selection in social research. *Sociological Methodology, 25*, 111–163.

Ramaswamy, V., DeSarbo, W. S., Reibstein, D. J., & Robinson, W. T. (1993). An empirical pooling approach for estimating marketing mix elasticities with PIMS data. *Marketing Science, 12*(1), 103–124.

Raykov, T. (1997). Estimation of composite reliability for congeneric measures. *Applied Psychological Measurement, 21*(2), 173–184. http://eric.ed.gov/?id=EJ598351

Rindskopf, D., & Rose, T. (1988). Some theory and applications of confirmatory second-order factor analysis. *Multivariate Behavioral Research*, *23*(1), 51–67.

South Carolina Department of Education. (2013). *ESEA federal accountability system: calculating the grades for districts and schools, technical manual*. Columbia, SC: Author. Retrieved May 5, 2015, from http://ed.sc.gov/data/esea/2012/documents/ESEA_Technical_Documentation-Draft.pdf.

South Carolina Department of Education. (2014a). *Data for schools*, *2012/13*, database extract provided to authors. Columbia, SC: Author.

South Carolina Department of Education (2014b). *SCPASS score report user's guide*. Columbia, SC: Author. Retrieved May 5, 2015, from https://ed.sc.gov/agency/programs-services/45/documents/2014SCPASS_UserGuide.pdf

South Carolina Department of Education (2014c). *End-of-course examination program score report user's guide*. Columbia, SC: Author. Retrieved May 5, 2015, from https://ed.sc.gov/agency/programs-services/41/documents/EOCEP-2013–14-ScoreReportUsersGuide.pdf.

South Carolina Department of Education (2014d). *HSAP score report user's guide*. Columbia, SC: Author. Retrieved May 5, 2015, from https://ed.sc.gov/agency/programs-services/43/documents/HSAP-2014-UsersGuide.pdf.

South Carolina Education Oversight Committee. (2011). *2011–2012 accountability manual: the annual school and district report card system for South Carolina public schools and school districts*. Columbia, SC: Author. Retrieved May 5, 2015, from http://www.eoc.sc.gov/Information%20for%20Educators/Accountability%20Manuals/2012/Acct%20Manual%202011–2012%20for%20Web%2006302011revised03012012.pdf.

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