Identifying Schools Achieving Great Results with Highest-Need Students

Catalyzing Action to Meet the Needs of All Students

WORKING PAPER

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PUBLIC IMPACT

with

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School Needs Index and Success Measures Advisory Committee

Noah Bookman	CORE Data Collaborative, now Education Analytics
Veronica Conforme	UP Education Network
Cristina de Jesus	Green Dot Public Schools California
Nicole Dorn	UP Education Network
Annabelle Eliashiv	Green Dot Public Schools
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Sonali Murarka	Oakland Unified School District
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Forewords

A foreword from GREG LIPPMAN, Founder of the National Campaign for Highest-Need Students

How do we know when one school is better and more effective than others? And perhaps more crucially, given the challenges and crises of the current moment, what makes a school focused on the highest-need and most vulnerable students in our communities better than the rest?

In 2018, I founded the National Campaign for Highest-Need Students, an effort to ensure that schools that are having the most impact on student achievement for our least successful student populations are identified and recognized for their efforts, and that some of the most innovative, impactful educators in the country are supported in their work to spread their models to as many students and systems as possible.

But before any of that can happen at scale, we need to address a crucial question the answer to which has so far proven elusive: which schools work best for highest-need students? And why?

In our current accountability systems, even schools that are doing the best work locally (or even nationally) with struggling students are nearly always labeled "failing" schools. And the more high-need students these schools serve, the more their overall performance metrics suffer. In order to disrupt these systems and eliminate these blind spots, a better way of comparing schools is necessary, one that ensures that schools are compared with schools that are serving student populations that are demonstrably similar, and that are showing bend-the-curve impact with those students.

That is what the School Needs Index 1.0, the subject of this working paper, is designed to do. The School Needs Index uses previous student academic performance, as well as a host of demographic and economic indicators, to yield a nuanced profile of the level of student need at a school. And while there is much work still to be done here, this index is a crucial first step

toward giving system-level decision-makers the tools to accurately assess a school's true impact on its neediest students.

I want to thank the Walton Family Foundation and the Bill & Melinda Gates Foundation for their early support of the School Needs Index project, as well as the Scott Family Foundation, the Charles and Helen Schwab Foundation, Karen and Michael Gordon, the Margulf Foundation, the House Family Foundation, the Sobrato Family Foundation, and the City Fund for their support of the broader work of the National Campaign for Highest-Need Students.

I also especially want to thank and recognize all of the educators, advocates, and funders who have contributed to its development, including the members of this report's Advisory Committee listed above. It is the schools and models that have resulted from their tireless years of effort that the School Needs Index is designed to identify, and it is their work that is our best hope for a public education system that provides highest-need students and their families the schools and opportunities that they deserve.

A foreword from Education Analytics & the CORE Data Collaborative

The CORE Data Collaborative and Education Analytics partnered with the National Campaign for Highest-Need Students as part of our common focus on an equity and data driven understanding of public schools. A "one-size fits all approach" to schools misses one of the most important parts of engaging in the continuous improvement of the education system—understanding and addressing variation in student need in our schools. At the same time, an approach that considers every school to be totally unique would make it almost impossible to engage in the strategic and thoughtful support and management of schools, and every conversation would potentially devolve into unique perspectives on student need.

We believe the School Needs Index described here is designed to split the difference between these two extremes. By anchoring need in an outcome of interest like students' ability to read, write and comprehend, a needs index can help us look across schools to understand the variation of student need in a common, digestible and actionable way. We look forward to moving from the exploratory work described in this paper toward proof of concept efforts in areas like the city of Oakland.

Identifying Schools Achieving Great Results with Highest-Need Students

Catalyzing Action to Meet the Needs of All Students

INTRODUCTION

Even before the coronavirus pandemic, educators across the country reported students arriving on the first day of class needing unprecedented levels of support to thrive. Our education system applies labels to describe many of those needs—homeless, pregnant, students with disabilities, eligible for free and reduced-price lunch, and so on. But those labels capture just one small part of who students are, and speak nothing of what they can accomplish.

At the same time, too few schools today stand ready to help *all* students meet their promise. In fact, crude accountability systems often provide disincentives for the schools that want to serve students with the greatest academic needs. Meanwhile, schools that serve such students exceptionally well can go unnoticed—or even be labeled as "failing." As a result, other schools have no way of learning from and replicating their achievements. In fact, schools rarely even know what other schools serve a population like theirs. Schools serving the highest-need students—and their successes with such students—are too often invisible.

This was the experience of ACE Charter Schools, a network of schools serving highest-need students in San Jose, California. In response, ACE's founder, Greg Lippman, held a national convening in 2018, pulling together educators serving highest-need students along with funders and advocates from across the country. The convening sparked the National Campaign for Highest-Need Students, an initiative to ensure that highest-need students have schools that work for them.

To address the invisibility of schools serving highest-need students well, ACE partnered with Education Analytics, the CORE Data Collaborative, and Public Impact to change the definition of school quality, making visible the success that schools are achieving with these students.

This report represents our first steps toward that goal:

- **The "School Needs Index."** Section 1 explains our methodology for measuring the extent of support that students need to thrive academically. By calculating a School Needs Index for each school, we can help educators, policymakers, and the public gain a clearer understanding of the level and type of support that each school's students need to succeed.
- **Success Measures.** Section 2 explains methods to apply the School Needs Index to identify schools achieving outstanding results with highest-need students. With this kind of flashlight, we can point the way for many more schools to serve highest-need students exceptionally well.

The report also includes a series of appendices providing additional information about our analysis and the technical details that will allow other researchers to replicate our methodology.

Our hope is that the methods presented here will be immediately useful to educators and the agencies that oversee schools, providing tools to improve understanding of schools' challenges and their successes. At the same time, we acknowledge—and discuss extensively in this report—that the methods described here are "1.0." Our intent is to improve on them over time, and to invite others to join a national data collaborative with that aim. As we increasingly identify schools achieving success with highest-need students, we can turn to the critical work of understanding their success and sharing their practices widely, vastly increasing the share of highest-need students who attend schools that work for them.

Then we could apply what we learn to better serve highest-need students at scale.

The School Needs Index

When we talk about the level of student need at a school, we typically fall back on some familiar metrics. What percentage of students are eligible for free or reduced-price lunch (a conventional measure of poverty)? What percentage are English language learners? What percentage receive special education?

But these metrics mask as much as they reveal. Consider two schools, both with 100 percent of their students eligible for free lunch. What if you opened the schoolhouse doors and learned that the first school enrolled exclusively students who were involved in the juvenile justice system, half of them living away from their parents? What if the second school's students came

What if:

- We could empirically determine which student need factors were most related to student outcomes?
- We could accurately measure the level of student support needed at each school, allowing us to clearly see each school's success with their highest-need students and identify bright spots?

from households—most of them with two parents—in the low-income but relatively stable neighborhood surrounding the school?

You'd quickly conclude that when it comes to student need, defined as the level of support a school must provide its students to be successful, these two schools are actually very different. The 100 percent free lunch measure wasn't meaningless—both schools faced challenges you wouldn't see across town in a wealthy neighborhood school—but you'd want a way to acknowledge the differences in the need for support in each school.

Understanding that schools serve students requiring different levels of support is just a start. We can use that understanding to identify schools that are similar to one another, with an eye toward spotting schools achieving exceptional results with highest-need students. And we can use these measures of success to set ambitious but realistic targets for schools to shoot for with their highest-need students.

Calculating a School Needs Index

To understand the level of support needed by each school's students, we created a "School Needs Index." Our data set included dozens of student characteristics at the individual level. We categorized those into four "domains" (see the appendices for a full list of variables):

1. Student engagement (e.g., chronic absenteeism, suspension)
2. Demographics (e.g., migrant, new to the school, specific disability status)
3. Academics (e.g., prior ELA/math test scores, grade-point average)
4. Economics (e.g., homeless, estimate of family income)

We wanted to pull all of this information into a single score for each student, indicating the student's likely need for support. To do that, we needed to know how important each characteristic was in predicting students' success in school. If a characteristic was very predictive, we wanted to give it a great deal of "weight" in our scoring system. If it was less important, we wanted to give it less weight. As described in the appendices, we used statistical techniques to figure out these weights, based on the experience of the students in our data set and considering a variety of school-level factors.

One challenge was deciding what measures of "student success" to use in our model. For this analysis, we focused on success in math and English language arts (ELA) as measured by test scores. To be clear, we did not choose this path because of a belief that scores on math and ELA tests are the ultimate measure of student and school success. The extent to which students thrive throughout their lives, including in life beyond school, is our ultimate interest. And other student outcomes while in school, such as the development of personal competencies and social and emotional health, are also important. We chose to use math and ELA performance as our outcome metrics because they are leading indicators of how well students thrive after they leave school, and because they are readily available in the CORE data, as well as comparable data sets nationwide.

As we expand this work, we will expand the range of outcomes we analyze. And as we do, the specific weights attached to each student characteristic will likely shift as well. What we want to focus on here is our methodology for determining weights and the resulting index, rather than the specific weights we derived in this round of analysis.

The method we developed allows us to assign each student a score from 0 to 100, with a higher number representing a higher level of student support needed. To calculate a school-level School Needs Index score, we then averaged individual student support scores across the school.

Visualizing School Needs Index Data to Answer Key Questions

After computing the School Needs Index score for 3,000 schools in our data set, we developed visualizations to help us address four key questions:

1. What is the level of student need (School Needs Index score) for any particular school?
2. How do student needs vary across schools?
3. How do student needs vary by domain?
4. How do student needs vary among schools that seem similar on the surface (e.g., similar proportion of students eligible for free and reduced-price lunch)?

Although the next few pages linger over the Success Index, it is important to reiterate that the Success Index is not an end unto itself. Rather, the index provides a tool through which we are able to measure a school's success in a way that acknowledges differences in student needs. That allows us to identify and learn from comparable schools that are achieving exceptional results for students relative to other schools serving students with similar needs. The rest of this section focuses on answering the four questions above as a way to consider which schools are truly "comparable."

What is the level of student need (School Needs Index Score) for any particular school?

At its most basic level, the School Needs Index score described in this report aims to quantify the level of academic support that students need in their school. Figure 1 displays that need as a stacked bar graph, showing both the overall level of need (the top of the bar) and the relative need of each of the four domains—academic, demographic, economic, and student engagement—for one school.

In the example in Figure 1, Schools A's School Needs Index score is 87 on a scale from 0 to 100. The academic domain accounts for 74 of the 87 points, followed by demographic and student engagement (5 points each), and economic factors (3 points). The academic domain—students' prior academic performance—dominates this analysis because the outcomes we used in developing the index were academic outcomes, specifically ELA and math scores. As we use a broader set of outcomes, we expect the relative importance of domains (and specific characteristics) will change.

Figure 1. School Needs Index Score for School A

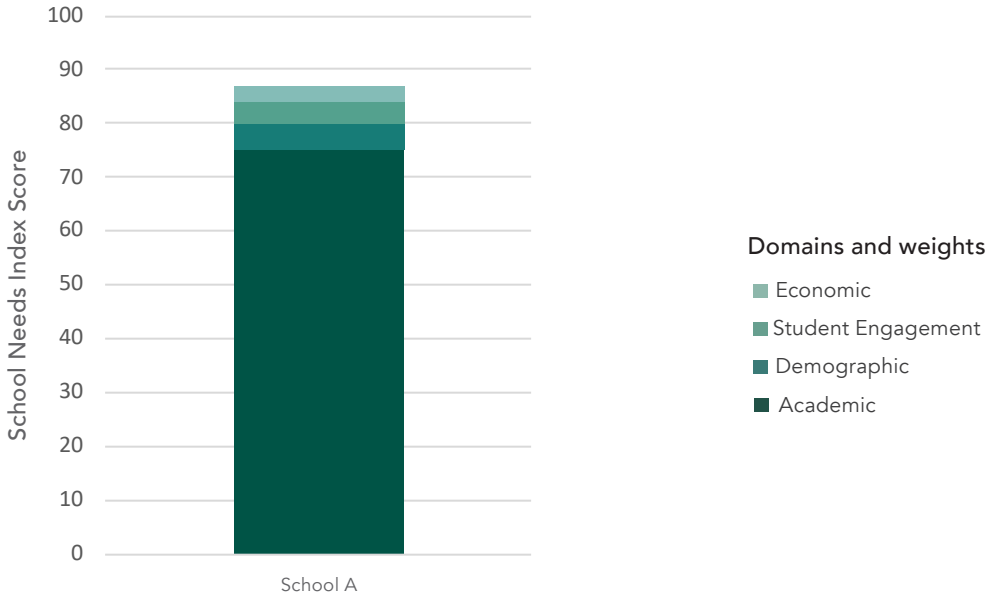
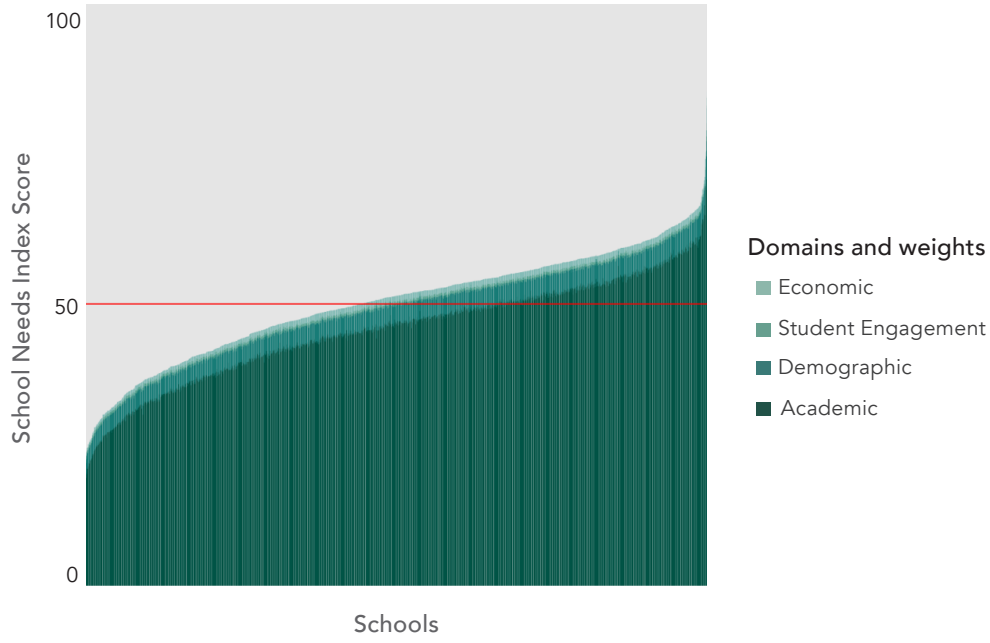


Figure 2. School Needs Index Score for all Schools in School A's District



How do student needs vary across schools?

Figure 2 allows us to put each school's School Needs Index score into context. In Figure 2, each bar represents a single school within California's CORE data set. A similar figure could be created for any group of schools—every school in a particular district, every charter school in a state, and so on. It shows that the level of need for academic support varies widely within this group of schools, with some schools having a School Needs Index score three times as large as those on the other side of the chart. The red line shows the average level of need, allowing us to see that many schools fall above and below this midpoint.

How do student needs vary by domain?

Although the academic domain accounts for much of a school's School Needs Index score, it is certainly not the only domain that matters. To focus on the other domains, we re-ran the analysis, removing the academic domain from the model. See Figure 3 for the result, which highlights the variation in the other domains, with demographics being the most predictive domain, followed by economics and student engagement. Figure 3 also shows, however, that the composition of student support needed differs from one school to the next.

As a result, schools with a similar overall School Needs Index score may vary in the types and levels of student needs they serve. The three schools in Figure 4, for example, have an almost identical overall score (between 82 and 84), but differ in the three domains that make up the measure. School F and School G have about 65 points in the demographic domain and only 7 and 10 points on student engagement, respectively; in contrast, School H has 52 points of demographic domain and 18 points of student engagement. To better illustrate the differences, we zoom in on three schools with a similar level of overall need. This image shows how the composition of need can vary significantly by school

How do student needs vary among schools that seem similar on the surface?

In contrast with Figure 4, where the schools had a similar overall need, Figure 5 (page 12) includes four schools that look very similar on a particular measure of need: 100 percent of students at all four schools receive free or reduced-price lunch (FRL). Despite this surface similarity, these schools are dissimilar with respect to overall need. While Schools L and N have a need of more than 85, Schools K and M score only 50 and 59, respectively, with the difference stemming from the demographic domain.

Each of these visualizations answers a different question, illustrating the potential power of the data to help educators, and the organizations that support them, understand the type and level of support needed to serve their students well. With that information in hand, it becomes possible to identify comparable schools, making "apples-to-apples" comparisons possible. As discussed in Section 2 (page 15), we can then identify schools achieving extraordinary success compared with comparable schools—and learn from them.

Figure 3. School Needs Index Score for all Schools in School A's District: Three Domains of Need

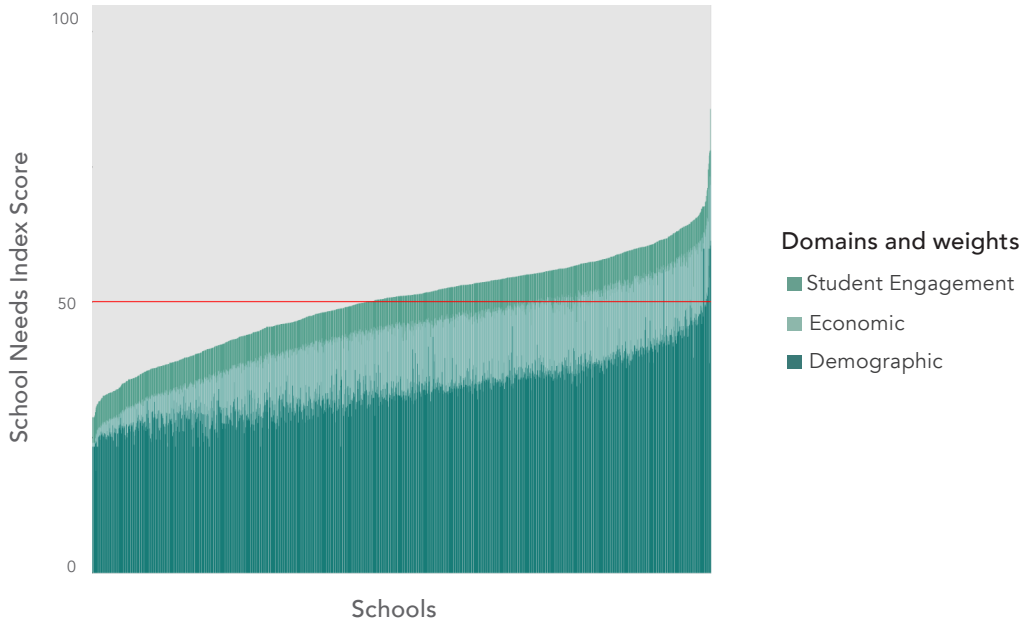


Figure 4. Schools with similar School Needs Index scores but different types and levels of need

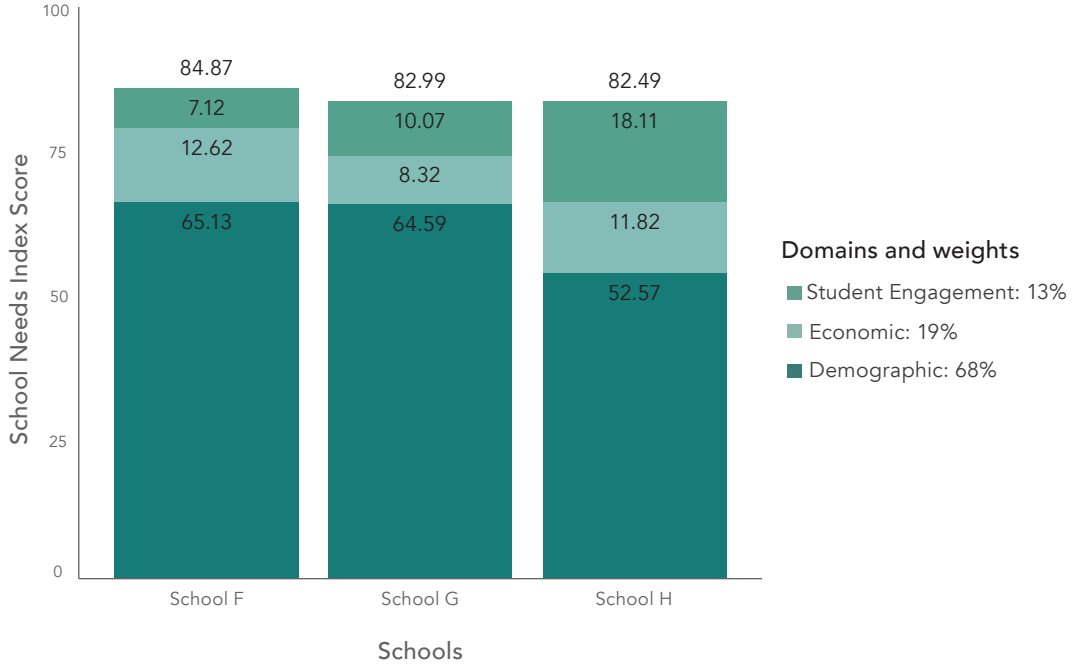
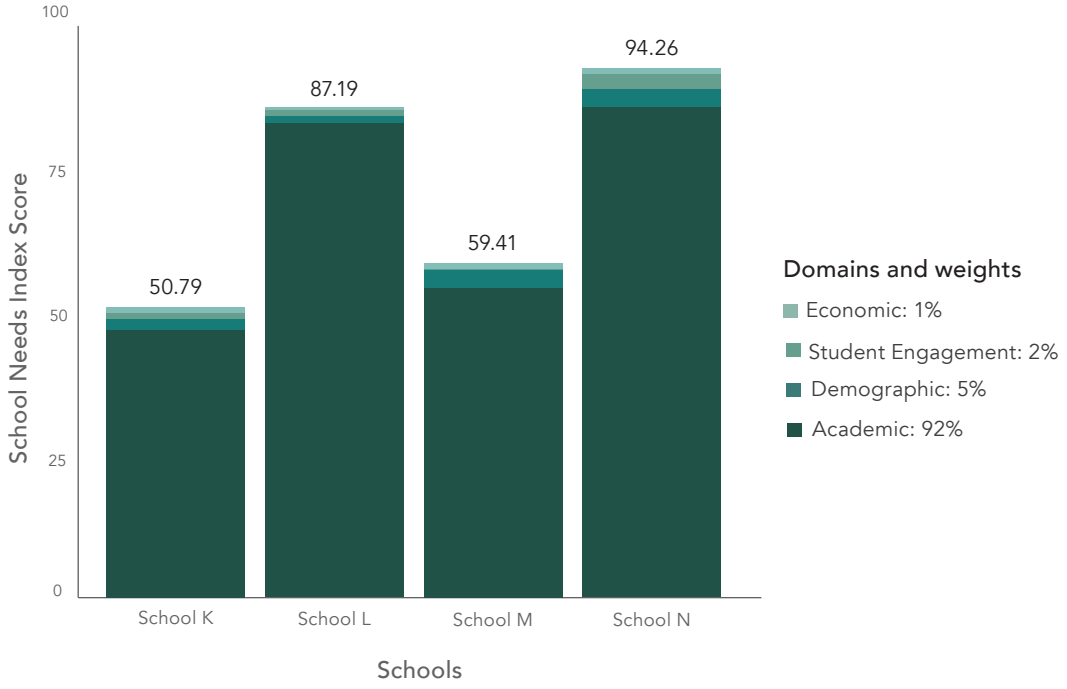


Figure 5. Schools with 100 percent FRL students but different types and levels of need



Takeaways from the CORE data: School Needs Index

The primary purpose of this report is to shed light on the methodology used to create the School Needs Index and the related success measures (described in the next section, beginning on page 15), rather than to describe specific findings from our analysis of the CORE data. Still, we want to note two important takeaways from our analysis with the caveat that results could differ significantly in different geographies, with additional years of data, or with different student outcome measures.

Consistency in predictive factors

First, the factors that predict ELA and math scores in the CORE data are largely consistent across grade levels and subjects. While predictive factors might differ using other outcomes that we hope to examine in the future (such as measures of post-secondary success), the consistency with which our model identified the same support factors across models gives us confidence that the School Needs Index is widely applicable across grades and subjects.

Prior performance—the most predictive factor

Second, students' prior test scores were by far the strongest signals of support needed when we analyzed the impact each domain seemed to make on student success as defined by achievement in ELA and math. This was not surprising; prior test scores capture the accumulated needs of students' lives, and those observed and unobserved factors would not change dramatically from year to year.

The fact that the "academic" domain is the largest factor in the School Needs Index does not mean, however, that prior performance dictates a student's (or school's) academic destiny. On the contrary, we find that schools (and thus students) with similar academic performance in the past can go on to achieve very different academic results, with some greatly exceeding our model's predictions. Nonetheless, knowing a student's prior academic performance is important because it signals the level of support that that student needs. And it is important to know the prior academic performance of the students entering a school for the same reason. Today, most methods used to report school characteristics fail to provide information about the academic records of a school's incoming students. This research shows that this is a major missing piece of current systems that needs addressing.

Data Considerations: School Needs Index Score

Our analysis highlighted several considerations for other researchers applying our methodology to create a School Needs Index.

Isolating the effect of the school on student need

Ideally, a school's School Needs Index score would entirely reflect factors outside of a school's control, such as family income and students' experiences in prior schools. We were not able to reach that ideal in our analysis, however, because some of the indicators that go into estimating a school's need in a given year reflect what happened to students in the same school the prior year. One could imagine a scenario in which a school made substantial progress on math and reading achievement with students from one year to the next, sending the school's School Needs Index score down, while another school that started with identical students but did not make similar academic progress would have a higher School Needs Index score.

Weighing the cost-benefit of additional variables

Some education agencies may want to include additional indicators that require significant resources to collect, such as information related to adverse childhood experiences. In those instances, they will need to weigh the benefit of those data points (what they tell us) with the time and expense of collecting them, as well as any student privacy concerns that arise. Further studies could shed light on the cost-benefit tradeoff of specific metrics.

Creating new variables

In addition to (or in lieu of) collecting additional variables of student need, policymakers and practitioners could *create* new variables by tracking changes in a particular variable over time. For example, they could create an indicator of the consistency of a student's FRL status, bottom decile performance, or student transiency and mobility over a particular time period.

Including special education data appropriately in the model

Students in special education are highly diverse and vary widely in their educational needs. As a result, simplistic metrics like the percentage of a school's students with individualized

education programs (IEPs) are not an adequate measure of need at the school level. Here, we explore some possible approaches to quantifying disability-related need. Though all have limitations, future research can shed light on the best methods for using these metrics.

- ***Disability codes.*** The U.S. Department of Education (USDOE) defines 13 disabilities for which students can receive special education services (such as specific learning disability, emotional disturbance, and traumatic brain injury),[1] and requires states to report annually on the number of students receiving services in each category. Some states even include additional categories. For example, in the analysis reported here, we were able to categorize students based on the CORE data's disability groups (see Appendix, page 20). In theory, some of these categories could be deemed more "high-need" than others, with the percentage of students in such categories serving as a better measure of need. In practice, however, student needs are also diverse even within these narrower categories of student disabilities.
- ***Educational environment.*** USDOE requires states to report the percentage of students receiving services in general education (inclusion) versus separate environments. Since students with more severe disabilities often spend more time in specialized settings, these data could potentially serve as a proxy for a school's level of disability-related need. Inclusion rates are not just a function of need, however. They also reflect policy choices at the state, district, and school levels. Two schools with identical student populations could have very different inclusion rates because of their divergent approaches to educating students with disabilities.

  This phenomenon plays out clearly when comparing inclusion rates at the state level—almost 84 percent of special education students in Alabama learned in a general education classroom for 80 percent of the day or more in the 2017–18 school year, while in New Mexico, Montana, New Jersey, and Hawaii, the same was true for less than 50 percent of all such students.[2] There is no reason to think these differences reflect a vastly lower level of need in Alabama; policy and resources are likely the driving forces.
- ***Funding amount.*** States establish and publish funding formulas based on disability categories. Funding levels are based on estimated costs, placement guidelines, and other administrative factors. Similar to inclusion rates, these formulas vary widely based on policy choices, and therefore are not necessarily good indicators of school-level need.
- ***IEP data.*** Individualized education programs, required for all students receiving services, could potentially provide standardized information about special education students across states. All IEPs include details about the related services that students receive (such as physical therapy or speech-language pathology services), whether they have curricular accommodations or modifications (such as, has their learning goal been changed?), or if they are on a diploma or alternate certificate track. All schools may not compile this level of data in an easily accessible database, however, even though each IEP is required to contain the information. If these or other variables could be collected across schools, indices may find that they better demonstrate a consistent level of need for special education students.

Some combination of disability codes, education environment data, funding categories, and IEP data could yield a more accurate measure of academic support needed than any one source alone, but in light of these challenges, more research and testing is needed.

Methodologies for Measuring School Success and Identifying Bright Spots

In the previous section, we presented a methodology for defining the academic support a student or school needs (a School Needs Index) based on four kinds of student factors—academics, demographics, economics, and student engagement—for the purpose of identifying "comparable" schools. In this section, we turn to measuring school success—how well schools improve the outcomes of their highest-need students relative to those comparable schools.

We created this methodology with the goal of uncovering "bright spots," schools that seem to achieve higher levels of student growth than our model would predict given the needs of their students. Our hope is that by identifying these bright spots, the field can also identify the core practices that set them apart, then replicate those practices in a more diverse group of school settings serving highest-need students across the country.

Measuring School Success

To calculate school success, we created what's known as a "value-added model." The model predicts the ELA or math performance for a school's students based on how schools serving students with similar needs tend to perform from one year to the next (though we aim to include multiyear longitudinal data in the future). The model then compares actual student growth at the school to the predicted growth. The more that actual student growth at a school exceeds predicted student growth, the higher its score and the more "successful" the school (or, the more "value" the school "adds"). Moreover, the model allows observers to make an apples-to-apples comparison of student achievement in schools with similar levels of student need. In effect, this levels the playing field between schools, giving a clearer view of their performance considering their different needs. See Appendix 1 for more detail on our methodology.

Visualizing School Success Data to Answer Key Questions

As we did with the School Needs Index, we again developed visualizations to help shed light on key questions:

1. Which schools serving significant proportions of highest-need students seem to be most successful?
2. Which schools seem to be most successful serving a particular group of high-need students?

Which schools serving significant proportions of highest-need students seem to be most successful?

Figure 6 plots each school as a single dot. The farther to the right a school's dot is, the more support its students need based on the School Needs Index. The higher a school's dot is, the greater the growth of its students—in this example, in fourth-grade ELA. So, a school with a dot in the upper right of the chart is both relatively high-need and high-growth in fourth-grade ELA.

It is clear from this chart that schools at all levels of need have a wide range of success in fourth-grade ELA growth. For example, schools A, B, and C all need high levels of support. But school A's fourth-grade ELA growth is very high, while B's is more average, and C's falls below that of most schools. In fact, School A's School Needs Index score is among the highest in the data set, but it has one of the highest levels of growth. We consider schools like School A "bright spots" that may be able to share promising practices and approaches driving their success.

Which schools seem to be most successful serving a particular group of high-need students?

As noted earlier, our model allows us to measure school success with a particular school group or student need. The result is Figure 7, which shows the value-add a school has on different student groups within the school.

Figure 7 depicts, for one school, three levels of detail for math that increase from left to right. The "Overall" bar chart on the left shows the school's average success in raising test scores for students overall, scaled as a percentile. This school's success in its impact on all students is approximately at the 87th percentile of all schools—that is, its impact is as high as or greater than that of 87 percent of all schools in the data set.

The "By Need Level" graphic in the middle column shows the next level of detail. We divided the school's students into three groups based on their individual support scores. The graphic shows that this school was highly successful with its highest-need students, and moderately successful with its middle- and lowest-need students.

The "thought bubble" in the right-hand column shows the school's success with students in the highest-need group with each domain of need. For example, this school does especially well with students with high academic and student engagement needs (those in the top third of all students in these domains). It does moderately well with students with high economic and demographic needs. Though not shown here, the analysis could drill down even further, showing the school's success with more specific subgroups within domains.

Takeaways from the CORE data: School Success

As noted earlier, this report does not aim to dwell on the results of our analysis of the CORE data. But two takeaways seem worth highlighting with the caveat that they may not hold true using other or additional years of data.

School success scores are similar regardless of need

We explored how student success varied by dividing schools into five equal-size groups ("quintiles") based on their School Needs Index score and finding the median Success Score for each.

Figure 6. School success by level of need

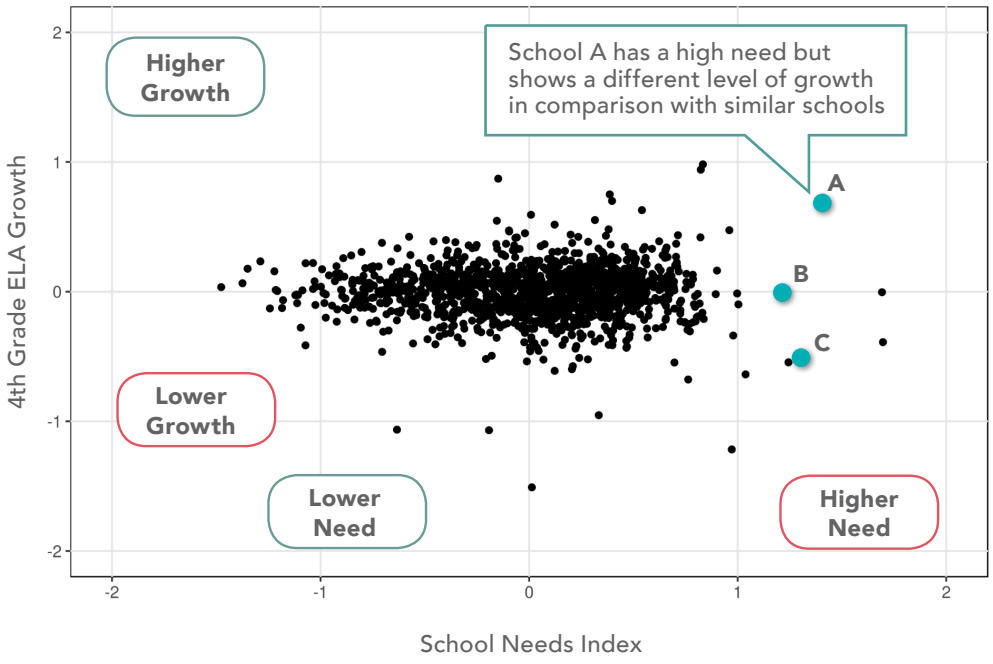
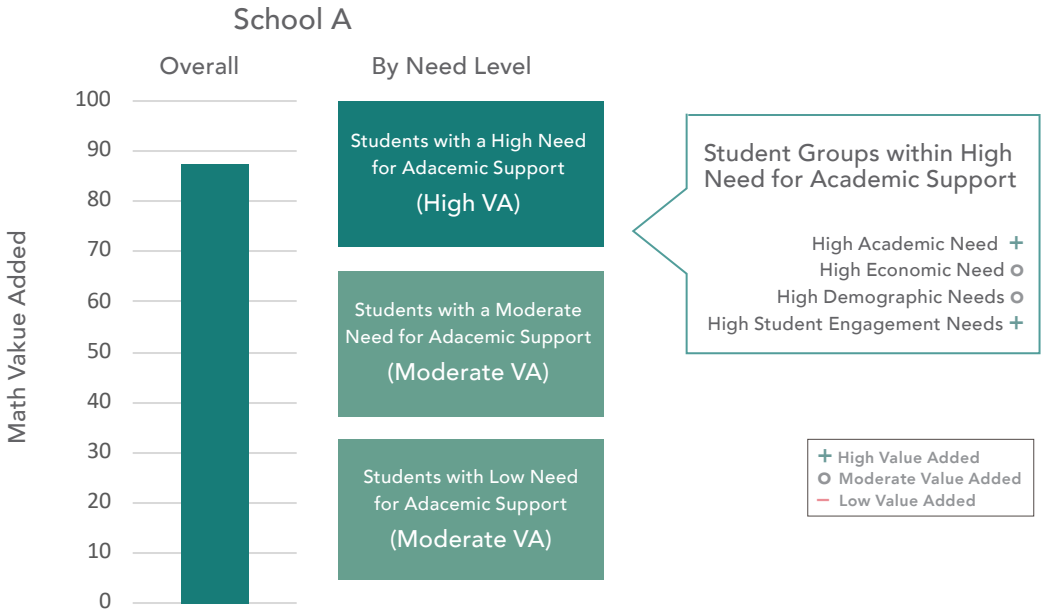


Figure 7. School success by three levels of detail



Through that process, we found little difference between quintiles (see Appendix 2, page 22). These findings are heartening; they suggest that on average, schools enrolling many students who require high levels of academic support achieve the same level of success as schools that enroll students who require less support. They also validate the role of a School Needs Index score like the one we created to separate the impact the school is having from the students the school is serving. In contrast, traditional accountability systems generally compare schools based on student achievement, irrespective of differences in student need. Yet schools serving many high-need students who arrive performing far below grade level tend to have lower proficiency rates: Even if they are producing strong student growth, that growth may not be sufficient for enough students to reach proficiency.

More outliers at higher School Needs Index scores

We also observed that among schools with higher School Needs Index scores (indicating higher levels of student need), we see more outliers in both the positive and negative directions. This suggests that the school in which the highest-need students enroll has a much bigger impact on their performance outcomes than for their peers with the lowest needs—all the more reason to identify the most successful among them and the practices underlying their success.

Data Considerations: School Success

Our analysis highlighted several considerations for other researchers applying our methodology to measure school success.

Identifying outliers

One primary goal of our work is to identify schools with comparable levels of student need, and which among them were the bright spots—schools with significantly greater success than their peers. To identify such outliers, however, it is critical to apply consistent decision rules, including:

- **A threshold for success**. This is the level of success needed to qualify as a bright spot, such as being at or above 70th percentile of growth for comparable schools, or showing statistically significant higher growth than the mean for comparable schools, etc.
- **The number of years at or above the threshold**. Meeting the threshold for success one year may be due to atypical circumstances—so then how often must a school meet the threshold to be a bright spot? And must those years be consecutive, or could it be something like two out of the last three?
- **The number of outcome metrics at or above the threshold.** An analysis might look for outliers on a specific success metric (such as ELA performance or post-secondary readiness), or across multiple success metrics.

As an example, an analysis could define bright spots as schools at or above the 95th percentile (relative to schools with a comparable School Needs Index) in math and ELA for three consecutive years. To reach the best option, analysts should experiment with different combinations to yield a reasonable number of schools.

We note that these decision rules constitute only the first stage of the process; the real value is in understanding how and why some schools shine. Educators and policymakers must understand what bright spots do differently to enable them to replicate the results and benefit more students.

Limits of "value added"

We use a standard value-added methodology to estimate school success, but the limitations that apply to all value-added models apply here (for example, the need for multiple years of data to get a strong signal of the school's success). Notwithstanding those limitations, the value-added methodology here provides a much stronger signal of school success with highest-need students than many commonly used measures. Future work can improve on the analysis here by expanding the definition of success beyond ELA and math performance.

Sample size

Analyzing school success for specific subgroups of highest-need students requires large sample sizes. Many data sets will be much smaller than CORE's, pointing to the importance of forging data collaboratives through which research can analyze multiple data sets with similar methods.

Next Phases of the Search

The School Needs Index and School Success metrics presented here mark only the first stage of a larger effort to improve how we serve the highest-need students. It is our sincere hope that this work will help independent researchers and education agencies identify schools serving groups of highest-need students exceptionally well so that we can learn and scale up their approaches. In future work, we will (and encourage others to):

- Explore additional outcome metrics beyond math and ELA outcomes, including the many other academic and nonacademic metrics that so many schools serving high percentages of highest-need students already use
- Use more longitudinal data to find indicators of need that appear only over the course of years, and that can be based solely on factors outside the influence of a student's current school
- Add additional indicators of student support needed by more effectively capturing concepts like the severity of disability or the depths of a student's poverty or trauma
- Apply the analysis to different data sets to see what might be generalizable beyond CORE

We conclude this phase on an optimistic note. **Some of the students in the data faced so many challenges, and though they needed tremendous amounts of support, it was not more than schools could give.** For every group of students, a group of schools successfully provided the support they needed. The challenge moving forward is to learn from these schools and spread their practices so that many more of the highest-need students can excel.

Appendix 1: Methodology

Creating a School Needs Index

The model can be written as:

$$Y_{iskt} = \xi + X_{ikt}\,\beta_s + e_{iskt}$$

where:

- Y_{iskt} is the outcome test score in math or ELA for a student in the outcome year, for student i in subject s in school k in year t,
- ξ is the intercept of the model,
- X_{ikt} is a vector of characteristics for student i in year t,
- e_{iskt} is a student-level error term.

We estimated this regression using an errors-in-variables (EIV) method that accounts for measurement error in any student characteristics that may need correction, such as prior test scores.[3] We used conditional standard errors of measurement for the Smarter Balanced Assessment Consortium (SBAC) math and ELA assessments.

After estimating the model, we used the coefficients β_s to create a prediction of the outcome for any individual student. To do this, we multiplied the coefficients we estimated for student characteristics by the observed values of the student's characteristics.

$$\hat{Y}_{iskt} = \hat{\xi} + X_{ikt}\,\hat{\beta}_s$$

This prediction is our best estimate of the student's math or ELA test score at the end of the school year, absent the impact of an intervention (being in a high-growth school or receiving additional support). The lower a student's predicted score is, the higher a student's need for academic support. Correspondingly, we define school need as the average predicted score of the school's students.

We categorized the student characteristic variables X_{ikt} into domains to investigate how much different kinds of variables contribute to overall need. To do this, we broke X_{ikt} into "domains," which we will call X^1_{ikt} and X^2_{ikt} (there can be any number of domains). As an example, in this analysis we partitioned variables into four domains: student engagement, demographics, academic, and economic. Then we created a "partial" prediction of the outcome for a student using just that subset of variables. The following formula shows the domain-specific partial prediction for domain 1 and domain 2.

$$\hat{Y}^{D1}_{iskt} = X^{D1}_{ikt}\,\hat{\beta}_s$$
$$\hat{Y}^{D2}_{iskt} = X^{D2}_{ikt}\,\hat{\beta}_s$$

For domain 1, the formula allows us to calculate the proportion of differences in the outcomes that is explained by the variables in domain 1 (similar to an R-squared measure for domain 1). We can think of this as the "effective weight" of domain 1's contribution to the overall prediction.

$$R^{2\,(D1)} = \frac{SD(\hat{Y}^{D1}_{iskt})}{SD(\hat{Y}^{D1}_{iskt}) + SD(\hat{Y}^{D2}_{iskt})}$$

To put the predictions on a more intuitive scale, we re-scaled the sum of the components into a "Support Index" in which values fall in a range between 0 and 100 and tend to be concentrated mostly between 30 and 70.

$$NI_{ik}^{D1} = \frac{-20}{SD(\hat{Y}_{iskt})} + 50 * R^{2\,(D1)}$$

The total Support Index score at the student level is the sum of the domain components.

$$NI_{ik} = NI_{\text{ik}}^{D1} + NI_{ik}^{D2}$$

In order to investigate the school-level total Support Index, we simply averaged the individual support indices of all students in that school for that subject.

$$NI_k = \overline{NI_{ik}}$$

Measuring school success

Our model to measure school success controlling for student needs can be represented as shown.

$$\alpha_{skt} = \overline{Y_{iskt} - (\xi + X_{ikt}\beta_s)}$$

or

$$\alpha_{skt} = \overline{Y_{iskt} - \hat{Y}_{iskt}}$$

School success with students with specific needs

We adjusted the model to determine school success in supporting specific student needs as well. In the model, we represent the subgroup of interest as subgroup *g*. Then we take the mean difference between the end-of-year test scores and measure of need by school, subject, and grade while only including students classified in group *g*. The school effect of the mean difference between test scores and measure of need for the group by school is the measure of how well that school does with students in this group. This model can be represented as shown.

$$\alpha_{skgt} = \overline{Y_{iskgt} - (\xi + X_{ikgt}\beta_s)}$$

or

$$\alpha_{skgt} = \overline{Y_{iskgt} - \hat{Y}_{iskgt}}$$

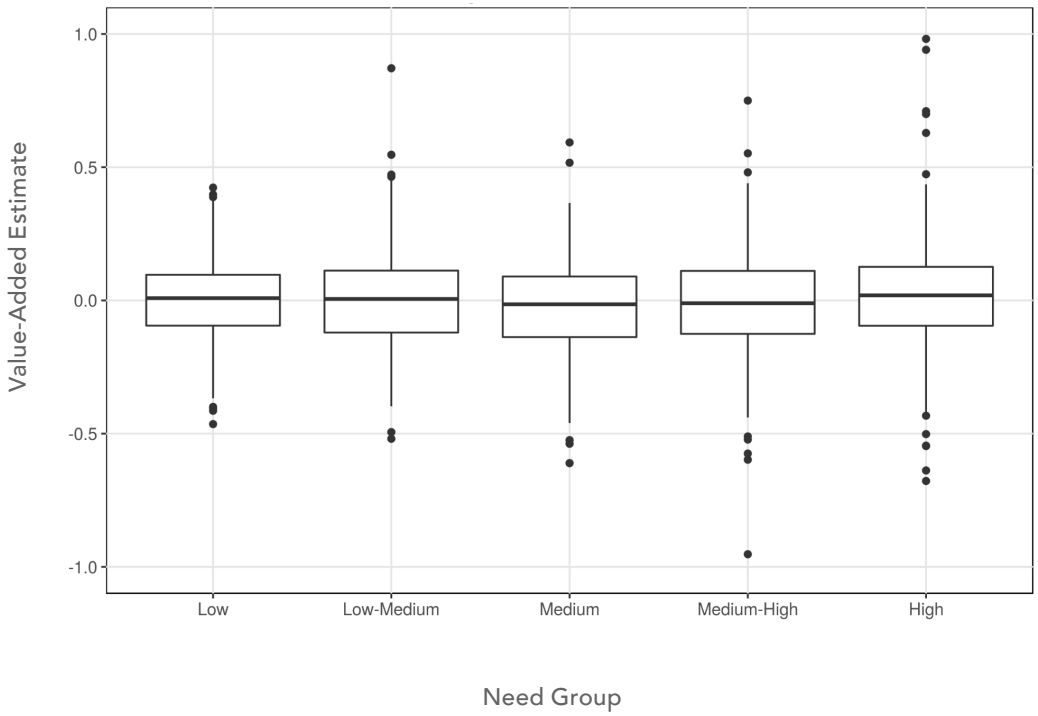
Appendix 2: Exploring variation in school success by level of need

Figure 1A below shows how the spread of value-added estimates in the school success model varies based on the level of student need at the school. It includes data from 1,366 schools divided into five quintiles on the X-axis based on student need. On the y-axis, we plot the value-added estimate for a given grade and subject. Each group of schools has its own boxplot. These boxplots can be interpreted in the following way:

- The tick line in the middle shows the median value-added estimate for that group
- The lower and upper lines of the box show schools between the 25th and 75th percentile of value-added, respectively. In other words, one quarter of the group is below the box and one quarter is above the box, while 50 percent is within the box.
- The vertical lines that go from the box to the top and to the bottom stop at the 95th and 5th percentile respectively. The points below and above those lines are outliers.

The figure shows that the median value-added estimate (Success Score) for schools was approximately the same regardless of student need, but that the spread tended to increase as student need increased, as evidence in the number and distance of outlier dots moving from left to right.

Figure 1A. Distribution of school success by need quintile



Appendix 3: Variables

Domain	Variable	Description
Academic	Math Pretest	The student's math score in the previous year
	ELA Pretest	The student's ELA score in the previous year
	GPA (grade-point average)	The student's previous year GPA (only for high school)
Economic	Free & Reduced-Price Lunch	Indicates a student's free or reduced-price lunch eligibility status
	Low Parental Education	Indicates student's primary guardian does not have a high school diploma
	Homeless	Indicates student has a homeless status
	Foster Care	Indicates student has a foster status
Demographic	Hard of Hearing/Deafness	Indicates student is hard of hearing or deaf
	Speech or Language Impairment	Indicates student has a speech or language impairment
	Visual Impairment	Indicates student has a visual impairment
	Orthopedic Impairment	Indicates student has an orthopedic impairment
	Other Health Impairment	Indicates student has other health impairment
	Intellectual Disability	Indicates student has an intellectual disability
	Traumatic Brain Injury	Indicates student has a traumatic brain injury
	Specific Learning Disability	Indicates student has a specific learning disability
	Emotional Disturbance	Indicates student has emotional disturbance disorder
	Autism Spectrum Disorder (ASD)	Indicates student has autism spectrum disorder
	Migrant	Indicates student participates in the Migrant Education Program
	English Language Learner (ELL)	Broken in four categories based on proficiency. ELL category 1 is the least proficient. Category 2 is in the middle, and Category 3 is the most proficient. Category 99 is for students who are ELLs, but their proficiency level is not known
	New to School	Indicates student is new to school in current year
	Race	Includes African American, American Indian/Alaskan Native, Asian, Filipino, Hispanic, Pacific Islander, and White
	Gender	Includes Female and Male

Student Engagement	Chronic Absenteeism	Indicates student was chronically absent in the previous year. Chronically absent is defined as when a student has an attendance rate less than or equal to 90%
	School Safety	Percent of students who feel safe in school based on climate surveys (only school average)
	Non-Continuous Enrollment	Indicates student was not continuously enrolled at one school in the previous school year
	Suspension	Indicates student was suspended in the previous year
	In-School Suspension (ISS)	Indicates student had an in-school suspension in the previous year

Deaf-Blindness and Established Medical Disability variables were available but were excluded because too few students in the data set had these disabilities.

Additionally, we include the following variable taken from the census data:

Domain	Variable	Description
Economic	Mean Neighborhood Income	Separate indicators for whether a student's zip code has a mean income in the bottom third or in the middle third of all students.

ENDNOTES

[1]United States Department of Education. (2017). Sec. 300.8 Child with a Disability. Retrieved from **https://sites.ed.gov/idea/regs/b/a/300.8**.

[2]United States Department of Education. (2018). Number and Percent of Students Ages 6 through 21 Served under IDEA, Part B, by Educational Environment and State. Retrieved from **https://www2.ed.gov/programs/osepidea/618-data/static-tables/index.html**.

[3]Fuller, W. (1987). Measurement Error Models, John Wiley and Sons.