Unpacking the Missouri Growth Model

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Key Points

The Missouri Annual Performance Report (APR) for public schools and districts gives more weight to point-in-time achievement on standardized tests (Status) than to student growth over time. We assert that the Growth component of the APR is a more important indicator of school quality than is Status. In this brief, we unpack the Missouri Growth Model used to calculate school and district growth scores. We explain how the model works and clarify what it does and does not tell us about school quality. We find:

- Growth is more independent of outside factors such as family income and thus a better measure of actual school performance than is Status.
- The Missouri Growth Model takes into account each student's expected growth and identifies whether students in a school on average grew more or less than expected.
- The Missouri Growth Model has limitations. It is unable to account for growth that occurs outside of school or at the top or bottom of the achievement distribution.

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Better evidence, better policies, better schools

Introduction

Missouri families, educational professionals, legislators, and taxpayers have an interest in ensuring our schools are effective at providing a quality education for Missouri children. Therefore, it is critically important that stakeholders have access to information that accurately illustrates the relative effectiveness of schools across the state.

There are numerous reasons for gathering information on school effectiveness. For one, under the federal Every Student Succeeds Act (ESSA), states must intervene to provide additional support for schools that are struggling and thus need a reliable and valid way to identify low-performing schools. It is also important to be able to identify schools that are doing exceptionally well, in the hopes that as a state we can learn from our best schools. However, school effectiveness can be difficult to measure.

The Missouri School Improvement Program, in its 5th iteration (MSIP5), uses a variety of measures to calculate each school or district's Annual Performance Report (APR) score. However, some have questioned the extent to which the APR measures true school effectiveness. In particular, there is good reason to question the APR's reliance on data that reflects student achievement at a given point in time (without accounting for various starting points for different students). As long as schools meet the achievement benchmark, even if their students perform worse than they did the previous year, those schools will not be

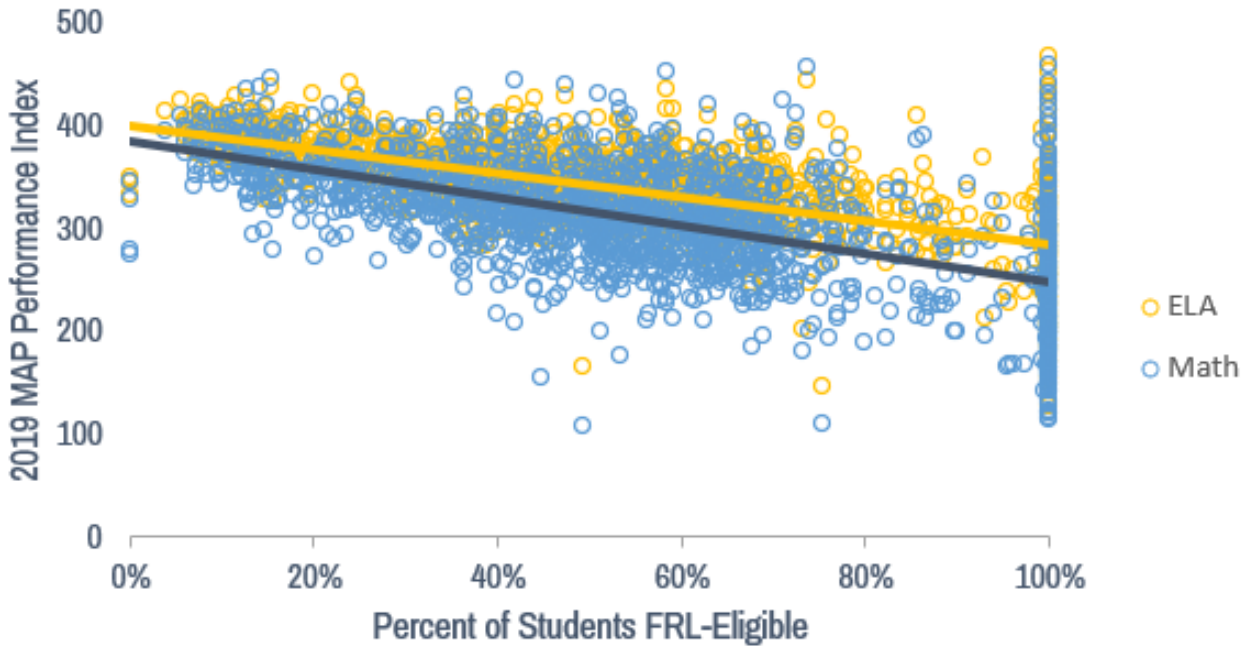
penalized in the current APR. Others criticize the APR for giving very high grades to almost all schools, doing little to distinguish between schools doing an excellent job and those showing more modest performance. However, there is one critically important measure that is a component of the APR: student growth. The APR Growth indicator is a measure of the change in achievement scores for individual students over time and does indeed take into account how well schools are doing at helping move students along the learning continuum over the course of the academic year.

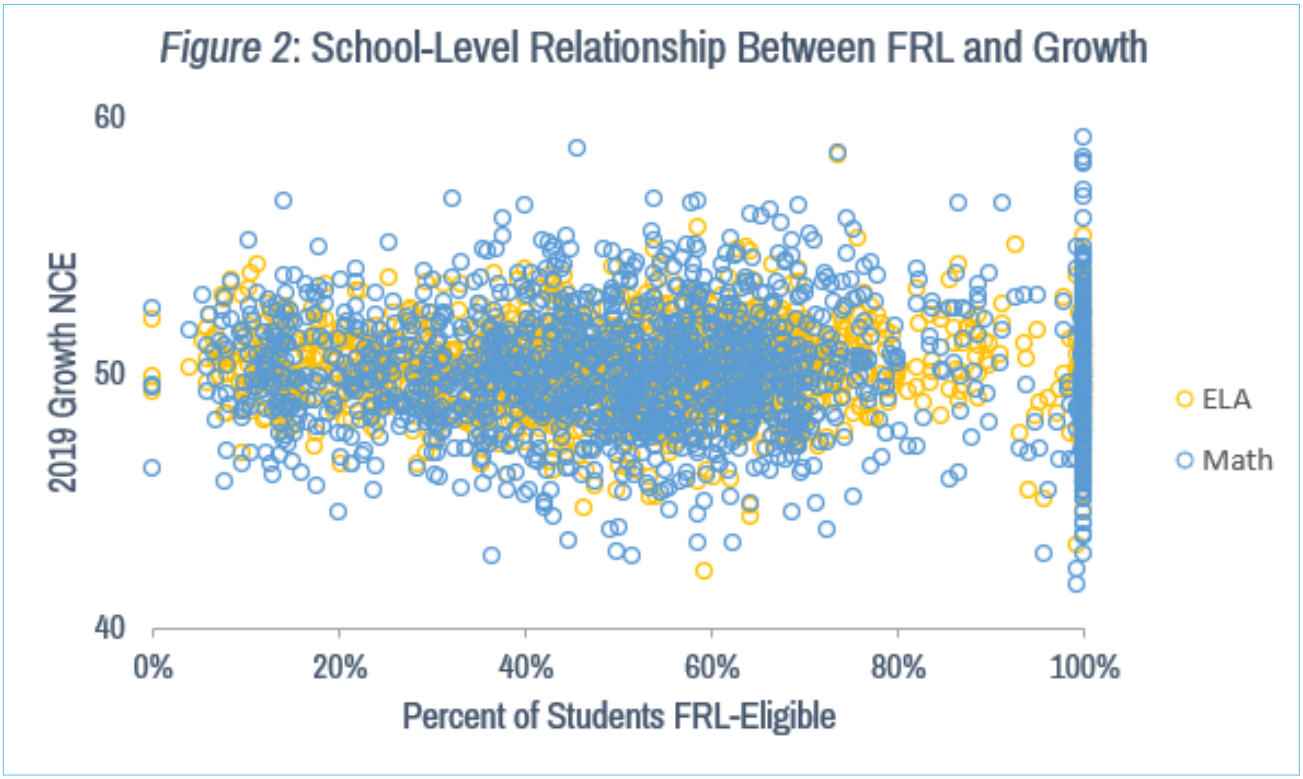
If we truly want to know which schools are effective, or high-performing, we at PRiME assert we should be spending most of our energy analyzing student growth. Thus, in this policy brief we unpack the Missouri Growth Model used to calculate school and district growth scores. We explain how the model works and clarify what it does and does not tell us about school quality.

Measuring Quality: Status v. Growth

One of the most straightforward (but limited) measures often used by the public to assess the quality of schools is the percent of students who score proficient or advanced on standardized tests, such as the Missouri Assessment Program (MAP) tests given each spring. The Missouri Department of Elementary and Secondary Education (DESE) evaluates and accredits its public schools using Annual Performance Report scores (APRs). The three-year weighted average of a school's performance on MAP tests determines the Status score on the APR report, and achievement measures such as Status are generally easy to understand. However, there is widespread agreement among educational professionals and researchers that achievement levels are inadequate to tell us about school quality. Decades of research suggests that performance on standardized tests is greatly influenced by out-of-school factors, particularly family income level. Students start kindergarten at various

Figure 1: School-Level Relationship Between FRL and Status





levels of readiness, and the achievement gap between students from low-income and high-income families persists throughout grades K-12. Thus, schools serving students from low-income families are often unfairly stigmatized for low performance. And schools serving students from middle- or high-income families are often given credit for high achievement that is at least in part due to family background and advantage.

Families also recognize that achievement levels do not tell the full story about a school. Two schools can look the same on paper based on test scores but can "feel" very different to students and parents in terms of school culture and teacher and student engagement, factors which are important to stakeholders but are much more difficult to measure. A team of researchers in Massachusetts is working with eight districts to develop a fairer and more comprehensive way to measure school quality that takes into account non-academic factors along with student learning.[1]

In the meantime, until we build a comprehensive and better way to assess school performance or quality, we at PRiME encourage stakeholders to focus on the best available data to assess school performance. In our view, while Growth is not a perfect measure (more on its limitations later), it is certainly more independent of outside factors such as family income and thus a better measure of actual school performance than is our traditional strategy of simply looking at Status. As shown in the figures below, as the percent of FRL-eligible students at a Missouri school increases, overall MAP test scores decrease in both reading (ELA) and math (Figure 1). However, there is little relationship between the percent of FRL-eligible students and Growth scores (Figure 2).

Despite this clear relationship between out-of-school factors and Status, the APR gives greater weight to Status than to Growth. While the APR is meant to reward a combination of Status, Progress, and Growth, currently, schools can earn all of their APR points for Academic Achievement based on Status alone. As long as schools meet the achievement benchmark, even if their students perform worse than

Table 1: ESSA Plan ES/MS Student Achievement and Student Growth Weights, Missouri and Border States

State	Achievement	Growth
*National**	*32%*	*36%*
Missouri	40%	30%
Arkansas	35%	50%
Illinois	20%	50%
Indiana	42.5%	42.5%
Iowa	14%	47%
Kansas	25%	0%
Kentucky**	20%	25%
Tennessee	30%	35%
Border State Avg.	*27%*	*36%*

*Does not include 7 states that do not weight the indicators or do not have standard weights (CA, MN, NE, NH, NC, PA, VA). **Kentucky's indicators have a range of possible weights; these are the middle values. Source: Education Commission of the States "50-State Comparison: States' School Accountability Systems"

they did the previous year, they will not be penalized in the current APR.[2]

This emphasis on achievement over growth can also be seen in Missouri's federal ESSA accountability plan. In contrast to Missouri, almost all of our border states and the majority of states nationwide give more weight to growth than to achievement (Table 1).

Measuring Growth: Technical Details

The Missouri Department of Elementary and Secondary Education (DESE) defines student growth as: "the change in achievement (as measured by the Missouri Assessment Program English language arts and mathematics assessments) for an individual student between two or more points in time."[3]

However, measuring growth is not as simple as looking at a student's test scores from one year to the next and calculating the difference between those two scores. State tests change over time and test scores from year to year are not directly comparable. Average performance also differs by grade and year.

In addition, experts in growth measurement agree that students should not all be expected to grow at the same rate. The Missouri Growth Model is able to take into account years of achievement data for all Missouri students and identify growth patterns: given a student who is achieving at a particular level, what can we reasonably expect their achievement level will be the following year?

In summary: "The Missouri model for calculating student growth uses student and district past performance to project future performance. Students' actual performance compared with projected performance is then evaluated against the state's targets."[4] The Missouri Growth Model allows the state to compare the growth of students who all started at relatively the same place in order to understand the impact of individual schools and districts.

Missouri Growth Model: Step by Step

Step 1: Predict each student's expected achievement and determine whether their actual achievement is higher or lower than the prediction, and by how much.

Step 2: Analyze the overall pattern of student growth in the school and compare the school's impact estimate to state targets.[5]

Step 1: Predict each student's expected achievement and determine whether their actual achievement is higher or lower than the prediction, and by how much.

The Missouri Growth Model uses a statistical model to predict student performance. By way of example, in order to predict a student's current year achievement in math, the model uses the following data:

- A student's prior year test score in the same subject (i.e. math)

- A student's prior year test score in the other subject (i.e. reading)
- The school's average prior year test score in the same subject (i.e. math)
- Whether the student was "mobile" (attended the school for less than a full academic year)
- The school's percent mobile (percent of students who attended the school for less than a full year)

The model uses all of this data to predict the student's current year math score. The student's predicted (expected) math score is subtracted from the student's actual math score to find what statisticians call the "residual," the difference between actual and expected. A positive number indicates the student grew more than expected. A negative number indicates the student grew less than expected.[6]

Step 2: Analyze the overall pattern of student growth in the school and compare the school's impact estimate to state targets.

The second step of the Missouri Growth Model is to estimate the school's impact. This is done by averaging the residuals of all students in the school to calculate a "raw growth effect" for the school. This "raw growth effect" expresses whether students in the school, on average, grew more or less than the state expected. The measure is initially expressed in a z-score (see statistical note below) but is then transformed to be on a different scale, Normal Curve Equivalents (NCE).[7] DESE explains the NCE in this way: "The NCE is a way of expressing a quantity and resembles a percentile. NCEs provide a way of comparing [schools] with similar prior achievement. NCEs around 50 indicate a contribution to student growth that is more or less typical, and that score predictions were generally met without either beating them or falling short. If the NCE is above 50, it means the students of a given school, viewed in the aggregate, outperformed predictions; if the NCE is below 50, it means the students of a given school, viewed in the aggregate—fell short of predictions."[8]

The important thing to understand is that an NCE of around 50 indicates that students at the school had "average" or typical test score growth from one year to the next and that student growth met state expectations. Student growth at a given school can also exceed or fall short of state expectations. Each school is given a "grade" on the APR of Exceeding, On Track, or Floor based on whether the average growth in the school was close to the expected growth for that school or was meaningfully above or below the expected growth. Each school receives an NCE score for math and an NCE score for reading.[9]

Measuring Growth: Subgroup

The above explanation applies to Standard 1 on the Annual Performance Report (APR). The calculations for Standard 2 are similar, with one important distinction. For Standard 2, the average growth of all students in the school who belong to the "subgroup," sometimes referred to as the "super subgroup," is compared to the average growth of all non-subgroup students in the state.

The subgroup includes all students who are Black or Hispanic, qualify for free or reduced-price lunch, are English Language Learners (ELL), or are students on an Individualized Education Plan (IEP). Students may fall into more than one of these categories. Standard 2 is concerned with whether these students are growing at a faster rate than students who are not in the subgroup. DESE provides the rationale for this standard: "The Standard 2 growth measure is designed to hold [schools] accountable for their efforts to close the achievement gap for these students. While it is very important to help all students reach

their full potential, achievement gaps will always remain if all students were to learn at the same pace."[10]

If a school has an NCE meaningfully above 50 on Standard 2, it means that the school is "contributing enough to the education of its most disadvantaged students that, in concert with similar successes across the state, there is hope of closing the achievement gap in Missouri."[11] On the other hand, if the school has an NCE meaningfully below 50, the school is actually contributing to a widening of the achievement gap.

Limitations and Conclusion

The Missouri Growth Model was researched and piloted from 2010-2012 before being adopted by the state. DESE acknowledges that growth measures are imperfect estimates and thus should be combined with other measures of student achievement. "Growth is just one factor in determining the success of a school, district, educator or educator preparation program. Growth should not be used as the single, determining factor in evaluations."[12]

The Missouri Growth Model takes into account the prior performance of students, which is the greatest predictor of current year performance. The statistical model also includes student mobility and some school-level factors, such as average mobility and average prior performance. However, these variables do not tell the full story about student-level and school-level differences that may impact the rate of student growth.

Growth also occurs outside of school, and this growth is not evenly distributed. Some families are able to arrange private tutoring for their children or engage their children in out-of-school learning activities that support academic progress. Student attendance, family resources, student health, family mobility, and neighborhood factors can also impact learning but are out of the control of the school.[13] Growth models, such as the one used in Missouri, typically do not take into account family income level or whether a student is an English language learner or on an Individualized Education Plan. Nor do these models account for the percent of students in a school who fall into one of these categories. Well-resourced schools are able to better support student learning by lowering class sizes and ensuring students have access to support staff such as counselors and social workers.

In addition, schools serving students from low-income families are affected by summer learning loss (or at least a relative lack of summer learning gains experienced by many students from middle- or high-income families). Statistical models compare end-of-year test scores from one year to the next, but students do not necessarily start the current year at the same place they finished the previous year. Some students may lose learning over the summer, while others continue to make progress, and these summer learning losses and gains are not factored into statistical models comparing end-of-year test scores.[14] Students who regressed during the summer experience more growth during the school year than the model gives credit for, and students who progressed during the summer experience less growth at school than the model suggests.

It is also important to acknowledge that the variables included in the statistical model are not always precise. For example, consider the mobility indicator. Student test score results are "assigned" to the school in which the current year test was taken, even if the student was not present for the entire school year. The student mobility variable attempts to account for this. However, the yes/no indicator does not differentiate between students who arrived one month

into the school year and students who arrived right before testing. Nor does it differentiate between students who attended numerous schools before moving to the current school and students who made only one switch in the middle of the school year. It is reasonable to assume these differences impact student learning.

Finally, standardized tests that are designed to measure whether students can meet grade-level standards may not accurately measure growth at the bottom and top of the achievement distribution. Students below grade-level who have made significant progress may not be able to demonstrate that on a test that is focused only on grade-level content. The same goes for students who are progressing in above grade-level material.

It is important to understand that these and other limitations affect any growth model. Growth models give an estimate of expected student growth, and an imperfect one at best. However, it is certainly better to evaluate schools using an imperfect growth model than no growth model at all. In other words, doing our best to predict student growth and then estimate the student growth that can be attributed to each school is certainly more desirable than evaluating schools based solely on the end-of-year achievement scores of students.

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Notes

[1] https://www.mciea.org/school-quality-measures.html

[2] Donaldson, K.L., & Rhinesmith, E. (2019). APR Scores: What they are and what they miss. Saint Louis University PRiME Center. https://www.sluprime.org/prime-blog/apr-scores

[3] DESE. (2013a). Missouri growth model: Executive summary, p. 1. https://dese.mo.gov/media/pdf/missouri-growth-model-executive-summary

[4] Ibid., p. 2

[5] We focus on the process for individual schools, but the same process is used for each LEA (district).

[6] The regression model uses z-scores rather than scale scores to predict current year performance. A z-score of zero indicates the mean for a given subject, year, and grade. Z-scores allow the state to calculate residuals in standard deviation units. "Mobile" is an indicator variable in which 1 means that a student attended the school for less than a full academic year. The model also includes an indicator of whether the off-subject prior-year test score was missing and the percent of students in the school with missing off-subject, prior-year scores. If a student's off-subject prior-year score is missing, the value is set to zero, the standardized mean for the state. If a student's same-subject prior-year score is missing, the score pair cannot be used for the analysis of average school growth and is excluded from the data.

[7] The Normal Curve Equivalent (NCE) is calculated through the following formula: 50 + (21.06 x [raw growth effect estimate]). 21.06 allows an NCE of 99 to represent the 99th percentile of the normal curve. In this case, the raw growth effect estimate (z) would be 2.33.

[8] DESE. (2013b). Missouri growth model: Step by step, p. 6. https://dese.mo.gov/media/pdf/missouri-growth-model-step-step. Note: Student growth is "assigned" to the school in which the student took the current year test, even if the prior year test was taken at a different school and even if the student attended the school for less than a full academic year. Student mobility and school percent mobile are both included as variables in the model predicting student growth.

[9] It is not enough to look at whether the NCE is above or below 50. If there is more variability in student growth in a school (if growth is "all over the map"), it is less likely that the difference from 50 will be

statistically significant. If there are fewer students whose test scores are included in the calculations (smaller sample size), it is also less likely the difference will be statistically significant.

[10] DESE (2013b), p. 8

[11] Ibid., p. 9

[12] DESE (2013a), p. 2

[13] Baker, E. et al. (2010) Problems with the use of student test scores to evaluate teachers. Economic Policy Institute. Briefing Paper #278.

[14] Ibid.

Other References

DESE. (2013c). Missouri growth model technical documentation. https://dese.mo.gov/media/pdf/missouri-growth-model-technical-documentation

DESE. (2014). Comprehensive guide to the Missouri school improvement program. https://dese.mo.gov/quality-schools/mo-school-improvement-program/msip-5