Missouri Growth Model
2024 Procedures and Results
University of Missouri
Department of Economics
Education Policy Research Team
December 3, 2024

Executive Summary

Multiple diagnostic analyses have been conducted on the results of the 2024 Missouri Growth Model estimates, and the key findings are as follows:

- Model performance continues to remain strong, with the EOC models seeing sizeable improvements in first-stage performance as compared to 2023.

- The LEA grade-level assessment growth measures have small and statistically insignificant correlations with free meal direct certification rates, while the mathematics growth measures also demonstrate no significant relationships with LEA or building underrepresented minority percentage. However, there is a statistically significant *positive* relationship between ELA growth and underrepresented minority percentage, while science growth is negatively correlated with this metric. The patterns are similar at the building-level, although the negative correlation between science growth and the direct certification rate is statistically significant at this level of aggregation.

- 2024 marks the first year that the science GLA exams were officially used in growth model estimation. The science GLA models performed well, with first-stage predictive metrics on par with those of the mathematics and ELA GLA models. However, the resulting science growth measures are consistently negatively correlated with two key demographic characteristics – percent of students directly certified for free meal receipt and percent underrepresented minority. That said, the correlations are relatively small (-0.08 to -0.16) and largely counterbalanced by positive correlations between these characteristics and mathematics and ELA growth.

- Key items/recommendations for 2025:

    - The University of Missouri team will begin producing estimated student-level growth targets that can be used by LEAs as a student-tracking tool. This follows from preliminary work conducted in 2024 (see the *Estimated Predicted MAP Exam Score Report* from 07/01/2024).

    - To enhance model performance, we plan to implement the following refinements in 2025:

        - In the EOC growth models, grade-8 mathematics and grade-8 Algebra I EOC scores will be entered as a single prior math exam score, with appropriate controls added to the model to account for the change.

        - A data censoring rule determined by an analysis of the student residuals produced by the GLA growth models will be applied to all first-stage student residuals.

    - The University of Missouri team will continue to monitor growth model performance to determine if any further model refinements, such as those noted in the previous point, are warranted. This monitoring is particularly important for the EOC growth models, which are still in their early years of use.

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1. MAP Grade-Level Assessments (Grades 4-8)

Procedural Overview / Summary

Following the standard Missouri Growth Model specification, the 2024 Missouri Assessment Program (MAP) grade-level assessment (GLA) scores were combined with MAP GLA scores from 2023 to estimate single-year student growth measures. Each student's growth measure is calculated as the difference between the actual score they earned in 2024 and a predicted score estimated based on the statewide relationship between student MAP exam scores in 2023 and 2024. This predicted score is primarily a function of a student's 2023 MAP exam scores in mathematics and ELA and their building's and LEA's average MAP exam scores (both subjects) from 2023. Following the specification used since 2022, the 2024 LEA and building growth measures are based on one year of student growth data. This differs from the pre-COVID Missouri Growth Model specification, where three years of student growth data were used to produce the growth measures.

In addition to growth measures estimated using all students assigned to a building or LEA, building and LEA growth measures were also calculated using only students who are members of the (traditionally disadvantaged) student group, which consists of students who are directly certified for free meal enrollment, underrepresented minorities (Black, Hispanic, and Native American), English-language learners, or students with an individualized educational plan. Moreover, new in 2024, growth measures were estimated using the MAP GLA science exam, which is administered in grades 5 and 8.

Data Preparation

MAP GLA score records from the 2024 test administration were retrieved and grouped by grade and subject. All score records with a scale score were used to calculate the mean and standard deviation for each subject and grade combination. The means and standard deviations were then used to rescale the scale scores into z-score units (mean = 0, standard deviation = 1) for each valid score record.

In the case of mathematics, students in grades 7 or 8 may have 2024 score records for the Algebra 1 end-of-course (EOC) exam instead of the grade-level MAP mathematics assessment. The means and standard deviations used to generate z-scores for these early Algebra I test takers included only score records from the grade 7 and grade 8 Algebra I test takers, and the exam scores were standardized by grade.

The second step in data preparation was to link each student's 2024 MAP score record to their MAP score record from 2023. For the 2024 growth model, a student exam score record was considered valid if its MAP score record from the current year (year t = 2024) could be combined with a valid MAP score in the same subject for the same MOSIS student ID from one year prior (year t-1 = 2023).[1] The grade levels in the matched student exam score records were also evaluated to make sure the grade in 2024 was one greater than the grade in 2023.[2] Student exam score records were dropped if this grade progression condition was not met.

[1] This condition was dropped for MAP science exam records. Student records were considered valid for the science growth model if the student had a 2023 MAP score record in *either* mathematics or ELA. The proper grade progression condition was still maintained for the science growth model.

[2] Algebra I score records from 7th and 8th grade students were matched to previous year MAP mathematics grade-level assessment score records. Each valid pair for a 7th grade Algebra I score included a 6th grade MAP mathematics score, and a valid pair for an 8th grade Algebra I score included a grade-7 MAP mathematics score.

After valid matched student exam records were constructed, additional predictor variables needed for the growth regression analyses were added to them. The other predictor variables include a variable indicating if the student was in the building where they were tested for less than a full academic year, a variable indicating if the student was flagged as delinquent or neglected, and aggregate measures of the four individual metrics, calculated both at the building and LEA levels. Specifically, the aggregate measures include the percent of tested students in the building less than a full academic year, the percent of students flagged as delinquent or neglected, and 2023 average scores for the same and off subjects.[3]

Table 1 on the following page presents a grade-by-grade summary of the number of 2024 MAP GLA score records retrieved, the number removed due to duplicate or invalid student IDs, means and standard deviations used to construct z-scores, the number of scores removed because of invalid grade progression or a missing prior-year exam score in the same subject, and finally the number of records used in the 2024 growth regression analyses.

As in previous years, there are no large differences across grade levels in the number of scores read-in and used in the regressions. The exception is grade-8 mathematics, where 17.2% of tested students had scores from the Algebra I end-of-course exam rather than the grade-8 mathematics assessment. This is in line with the percentage of grade-8 students taking the Algebra I end-of-course exam in 2023 but continues to remain slightly below pre-pandemic levels.

[3] English/language arts is the off subject when the 2024 score is from a mathematics exam, mathematics is the off subject when the 2024 score is from an English/language arts exam, and both subjects are considered off subject when the 2024 score is from the science exam. Off-subject data is included in the model as it increases its predictive power. In cases where a valid prior year score record in the off subject could not be found, the off-subject score was set to the standardized average (zero), and a binary indicator variable was set to true to indicate that the off-subject score was missing. The indicator variable was then interacted with the same-subject prior year score, increasing its predictive weight in cases with missing off-subject exam data. For the science model, a similar procedure was followed in cases where a student record had missing data for one of the two prior-year exam scores. Specifically, separate binary indicator variables were created for missing prior-year mathematics or missing prior-year English/language arts exam scores. (Students with neither prior-year exam score were dropped from the model.) These indicator variables were then interacted with the prior-year exam score in the other subject.

Table 1: Summary of 2024 MAP score records retrieved, removed, and used for growth modeling

Mathematics								
Grade	***3***	***4***	***5***	***6***	***7***	***8***	***Alg-7***	***Alg-8***
Total Score Records in 2024	63,924	65,014	64,903	65,312	64,914	54,893	618	11,431
Bad ID or Missing Score	855	816	814	927	1,034	1,139	0	2
Duplicates	0	0	0	0	0	0	0	0
Standardization Obs	63,069	64,198	64,089	64,385	63,880	53,754	618	11,429
Percent of Total Score Records	98.7%	98.7%	98.7%	98.6%	98.4%	97.9%	100.0%	100.0%
Mean	347.13	377.26	395.24	408.56	421.17	439.59	419.52	410.24
Standard Deviation	50.77	46.61	42.38	40.79	46.89	51.07	11.18	11.12
No Prior Score or Wrong Grades	63,069	3,212	3,187	3,359	3,385	3,205	12	222
Regression Obs	-	60,986	60,902	61,026	60,495	50,549	606	11,207
Percent of Standardized Obs	-	95.0%	95.0%	94.8%	94.7%	94.0%	98.1%	98.1%
English/Language Arts								
Total Score Records in 2024	63,841	64,941	64,812	65,231	65,496	66,662	N/A	N/A
Bad ID or Missing Score	1,194	1,137	1,097	1,193	1,273	1,335	N/A	N/A
Duplicates	0	0	0	0	0	0	N/A	N/A
Standardization Obs	62,647	63,804	63,715	64,038	64,223	65,327	N/A	N/A
Percent of Total Score Records	98.1%	98.2%	98.3%	98.2%	98.1%	98.0%	N/A	N/A
Mean	353.43	381.58	393.85	400.38	420.86	432.48	N/A	N/A
Standard Deviation	43.99	43.28	43.62	36.68	41.28	41.51	N/A	N/A
No Prior Score or Wrong Grades	62,647	2,972	2,982	3,134	3,232	3,325	N/A	N/A
Regression Obs	-	60,832	60,733	60,904	60,991	62,002	N/A	N/A
Percent of Standardized Obs	-	95.3%	95.3%	95.1%	95.0%	94.9%	N/A	N/A

Table 1 (Continued): Summary of 2024 MAP score records retrieved, removed, and used for growth modeling

Science								
Total Score Records in 2024	N/A	N/A	64,899	N/A	N/A	66,702	N/A	N/A
Bad ID or Missing Score	N/A	N/A	831	N/A	N/A	1,128	N/A	N/A
Duplicates	N/A	N/A	0	N/A	N/A	0	N/A	N/A
Standardization Obs	N/A	N/A	64,068	N/A	N/A	65,574	N/A	N/A
Percent of Total Score Records	N/A	N/A	98.7%	N/A	N/A	98.3%	N/A	N/A
Mean	N/A	N/A	297.70	N/A	N/A	492.33	N/A	N/A
Standard Deviation	N/A	N/A	41.42	N/A	N/A	40.54	N/A	N/A
No Prior Score or Wrong Grades	N/A	N/A	3,160	N/A	N/A	3,370	N/A	N/A
Regression Obs	N/A	N/A	60,908	N/A	N/A	62,204	N/A	N/A
Percent of Standardized Obs	N/A	N/A	95.1%	N/A	N/A	94.9%	N/A	N/A

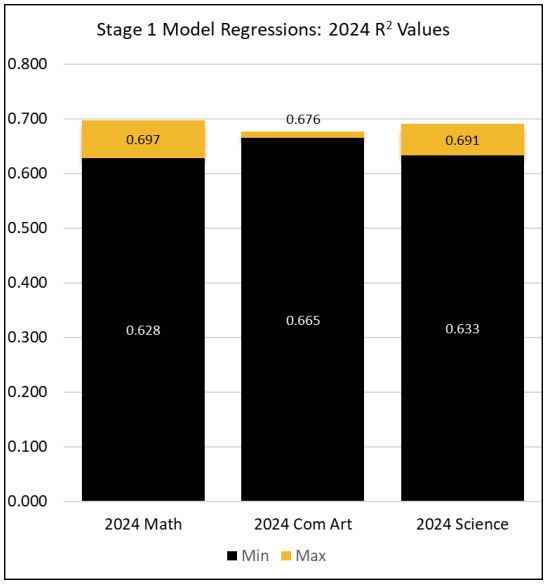
Notes: The number of records with missing scores includes students with an IEP who took the MAP-A exam but do not have a MAP scale score.

Regression Analyses

There are two stages in the regression analyses conducted to generate LEA and building growth measures for each subject. The first stage predicts each student's current MAP score based on his or her prior year MAP scores (same subject and off subject), the student mobility variable (in the building where tested less than a year), the delinquent or neglected flag, the average prior year MAP scores (both subjects) for the LEA and building (calculated based on the population of students with valid score pairs who took the exam in the LEA or building in time *t*, i.e., the *t-1* score of a student taking the exam in an LEA or building in time *t* is included in that LEA or building's aggregate, even if the student took the previous year exam in a different LEA or building), the percent of tested students in the LEA and building coded as mobile, and the percent of tested students in the LEA and building coded as delinquent or neglected. A separate regression model is estimated for each grade and subject combination. The predicted score generated for each student is then subtracted from the student's observed score to produce the student residual. The student residual is the individual-level growth measure for each student for the current year and is used in all second-stage regressions. A positive residual indicates the student outperformed the predicted value, while a negative residual indicates the opposite.

Results from the first-stage regression models for the grade-level exams are consistent with prior years. Because there are different regression models fit for different grades in each subject, Figure 1 graphically displays the minimum and maximum R^2 values from the first-stage regressions for the 2024 growth model.[4] For the grade-level examinations, the explanatory power of the first-stage models in 2024 is similar to that of 2023 and in line with pre-pandemic (2019) levels. In addition, the Algebra I end-of-course exam models saw improved first-stage performance compared to 2023, with R^2 values of 0.539 and 0.520 for the grade-8 and grade-7 Algebra I models, respectively. This is in comparison to values of 0.515 and 0.477 in 2023. In fact, the R^2 value for the grade-7 Algebra I model is larger than its 2019 value (0.468), while the grade-8 Algebra I model is approaching 2019 performance (0.565).

Figure 1: Variance in Student MAP Scores Explained by Stage 1 Regression Models



Following the first-stage predictive model, the second-stage regression averages the student residuals for each LEA or building using the student-level residuals from the current year in the given subject. The regression framework also produces a standard error for each LEA or building measure, which can be used for statistical testing and to produce confidence intervals for each growth measure. Multiple second-stage regressions are run for each subject, one each for the overall LEA and building growth measures that includes all student residuals assigned to the LEA or building and a separate set of regressions for LEA and building growth for students in the (traditionally disadvantaged) student group.

[4] R^2 values measure the share of the variance in students' MAP scores explained by the predictor variables.

After the second-stage regression, Bayesian shrinkage is applied to the LEA and building level growth measures, and quartile values are produced for reporting and APR purposes.[5]

Summary of Growth Measures and Correlations

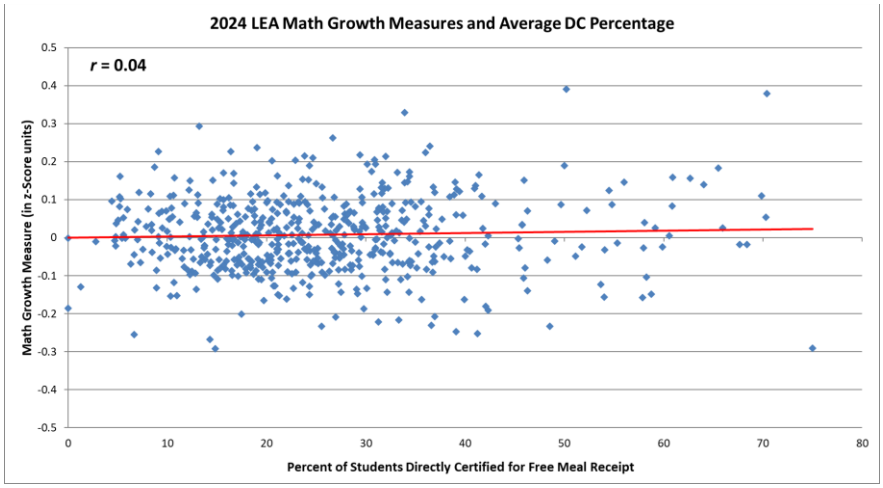
Post-estimation analyses conducted on the overall LEA and building growth measures involved examining correlations with measures of LEA or building demographics. An important goal of the Missouri Growth Model is to produce estimates of student growth that are not simply reflections of the demographic or socioeconomic characteristics of the students served by a building or LEA.

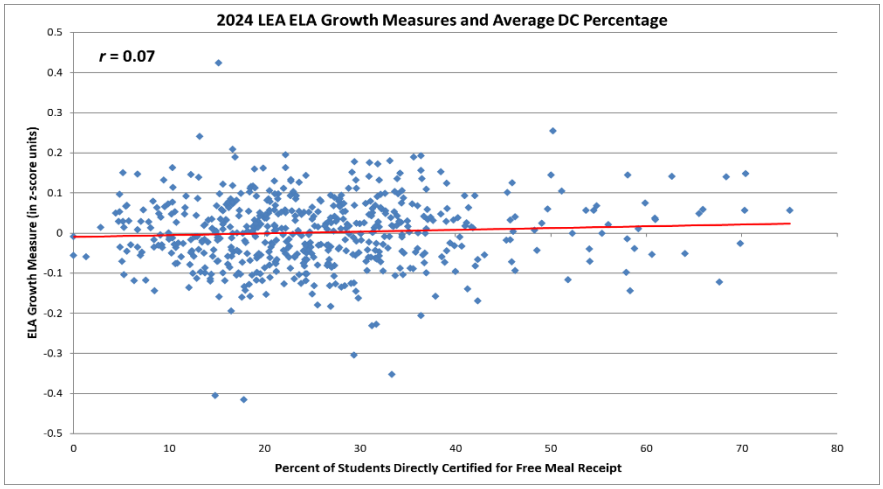
Figure 2 presents scatterplots of LEA growth measures and the percent of MAP tested students in the LEA who were coded as being directly certified for free meal receipt. The trend lines in the scatterplots show small (below 0.1) positive correlations between the percent of directly certified students and calculated LEA growth in both mathematics and English/language arts and a small negative correlation in science, none of which are statistically significant at 95% confidence level.

Figure 3 plots LEA growth measures against the share of tested students coded as members of underrepresented minority groups (Black, Hispanic, and Native American). The graphs illustrate the uneven distribution of minority enrollment in Missouri, with a large number of LEAs with low minority enrollments clustered on the left side of the charts and a less dense cluster of LEAs with high percentages of minority students on the right. Like Figure 2, the trend lines in the scatterplots indicate small (below 0.1) positive relationships between underrepresented minority enrollments and the LEA growth measures in both mathematics and English/language arts and a small to moderate negative correlation in science (-0.16), with the ELA and science correlations significant at the 95% confidence level.

[5] All LEA and building student group growth measures are re-centered on the statewide average student group residual, so that they have a mean value of approximately 0. Bayesian shrinkage adjusts the average growth measures toward the overall mean, with buildings and LEAs with noisier growth measures resulting from fewer score pairs or noisier student exam scores receiving a larger adjustment. If shrinkage is not applied, growth estimates from small LEAs and buildings are more likely to appear as outliers.

Figure 2: Scatterplot of GLA Growth Measures and Share of Tested Students Directly Certified for Free Lunch





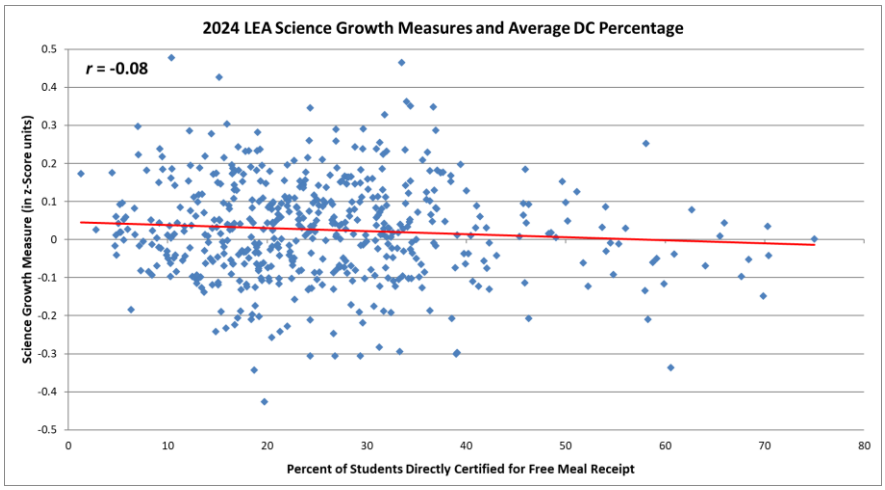
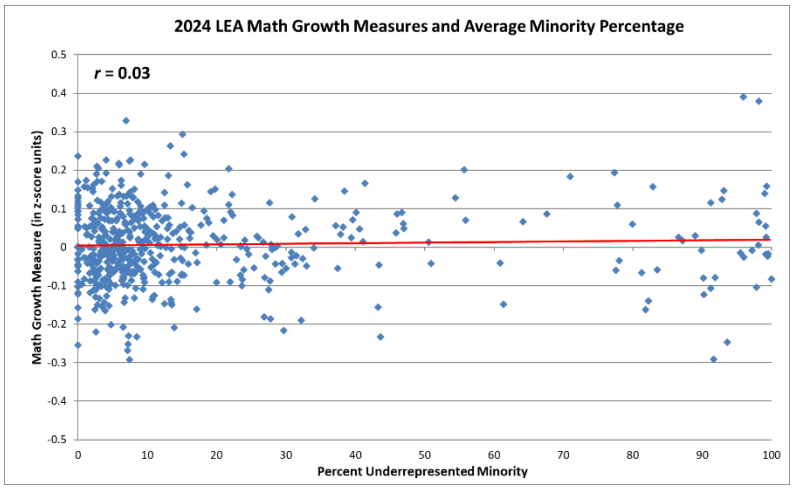
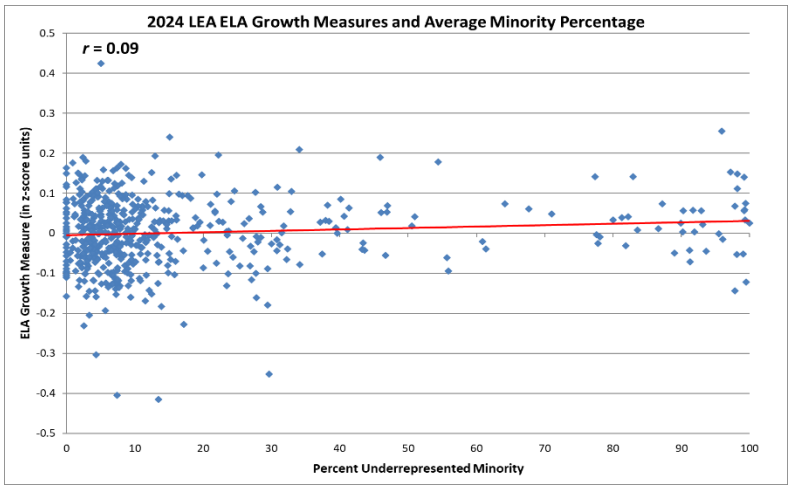


Figure 3: Scatterplot of GLA Growth Measures and Share of Tested Students in Underrepresented Minority Groups





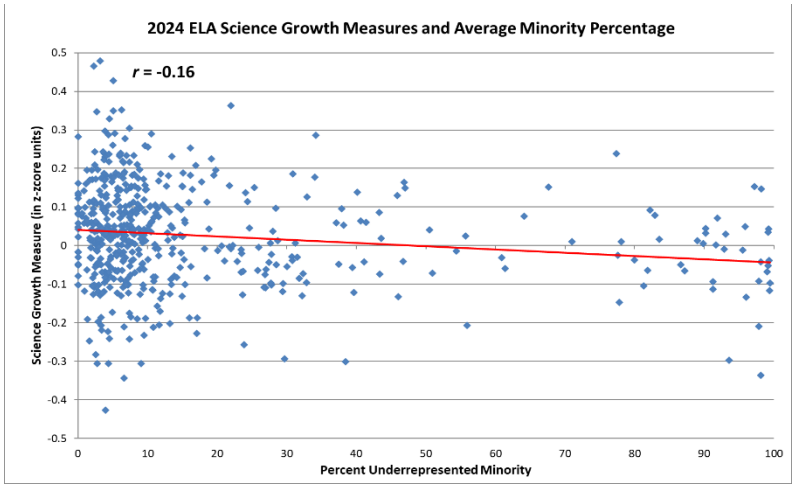


Table 2 presents correlation coefficients for the LEA growth measures reflected in the figures above and equivalent correlations based on building growth measures and building-level student demographic measures. The building-level correlations are of similar magnitude as those at the LEA-level.[6]

Table 2: Correlations between Growth Measures and Aggregate Student Demographics

	District Level Growth Measures					
	Math Effect	**ELA Effect**	**Sci Effect**	**FRL**	**DC**	**MP**
Math Effect	1.00	0.47	0.30	0.07	0.04	0.03
ELA Effect		1.00	0.42	0.06	0.07	0.09
Sci Effect			1.00	-0.03	-0.08	-0.16
FRL				1.00	0.80	0.43
DC					1.00	0.57
MP						1.00
	School Level Growth Measures					
	Math Effect	**ELA Effect**	**Sci Effect**	**FRL**	**DC**	**MP**
Math Effect	1.00	0.52	0.34	-0.02	-0.04	0.00
ELA Effect		1.00	0.44	-0.01	-0.03	0.06
Sci Effect			1.00	-0.06	-0.11	-0.13
FRL				1.00	0.84	0.54
DC					1.00	0.66
MP						1.00

Notes: Highlighted cells are statistically significant at $p < .05$

Furthermore, correlations between growth measures across subjects are moderate and range from 0.30 to 0.47 at the LEA level and from 0.34 to 0.52 at the building level, with the highest correlations occurring between mathematics and ELA and the smallest correlations occurring between mathematics and science.

[6] Scatterplots showing building-level growth measures and building direct certification and underrepresented minority percentages are presented in the Appendix.

2. MAP End-of Course Assessments (Grades 9-12)

Procedural Overview / Summary

End-of-course (EOC) growth models were estimated using the four EOC exams that are required for high school graduation – Algebra I, Biology, English II, and Government – because these exams have sufficient coverage and data quality to support robust growth model estimation. The EOC growth models are specified to parallel the growth models estimated using the grades 4-8 grade-level assessments as closely as possible. However, there are several key differences that should be noted:

- Grade-8 MAP GLA exam scores in mathematics, ELA, and science are used as the previous exam scores, as students who take an EOC in grades 10-12 grade do not have MAP exam scores from the immediately preceding year that can be used in the first-stage predictive model. For students who took Algebra I in grade 8, the Algebra I EOC score is used in place of the Grade-8 MAP GLA math exam. Furthermore, grade-8 science is included in the first-stage model as it is available at that grade level and can provide additional predictive information on students, which is important given the increasing gap between prior exams and the current year exam scores. These additional exams (grade-8 science and grade-8 Algebra I EOC) are also used in the calculation of the LEA and building prior exam score averages.
- Since there is no precise same-subject grade-8 exam for use in the EOC growth models, the restriction that a student must have a same-subject previous exam score has been removed. As a result, a student who took an EOC exam in 2024 and had *any* grade-8 exam available, is included in the growth model estimation.[7]
- Given that EOC exams can be taken in any grade from 9-12, the proper grade incrementation requirement used in the traditional grade-level assessment growth models is also dropped.[8]

[7] Binary indicator variables for every possible available previous exam score combination are included in the first-stage estimation to account for the differing student score profiles. In addition, the indicator variables are interacted with the available grade-8 exam scores to give the available scores more predictive weight in the presence of missing exam scores.

[8] As noted above, some students take the Algebra I EOC in grades 7 and 8. To maintain consistency with previous year growth model specifications, we continue to include these students in the grade 4-8 GLA math model growth calculations.

Data Preparation

With these key differences in mind, Table 3 presents a summary of the data used in the 2024 EOC growth model and parallels the information presented for the MAP grade-level assessments in Table 1.

Table 3: Summary of 2024 EOC score records retrieved, removed, and used for growth modeling

Algebra I				
Grade	***9***	***10***	***11***	***12***
Total Score Records in 2023	36,442	13,532	4,519	4,582
Bad ID or Missing Score	0	0	0	0
Duplicates	0	0	0	0
No 8th Grade Scores	2,359	1,361	1,021	4,316
Regression Obs	34083	12,171	3,498	266
Percent of Total Score Records	93.5%	89.9%	77.4%	5.8%
Biology				
Grade	***9***	***10***	***11***	***12***
Total Score Records in 2018	19,361	34,440	10,271	3,816
Bad ID or Missing Score	0	0	0	0
Duplicates	0	0	0	0
No 8th Grade Scores	1,289	2,922	1,608	3,476
Regression Obs	18072	31,518	8,663	340
Percent of Total Score Records	93.3%	91.5%	84.3%	8.9%
English II				
Grade	***9***	***10***	***11***	***12***
Total Score Records in 2023	846	61,627	2,322	3,126
Bad ID or Missing Score	0	0	0	0
Duplicates	0	0	0	0
No 8th Grade Scores	108	5,099	605	2,882
Regression Obs	738	56,528	1,717	244
Percent of Total Score Records	87.2%	91.7%	73.9%	7.8%
Government				
Grade	***9***	***10***	***11***	***12***
Total Score Records in 2018	3,208	4,967	46,664	12,116
Bad ID or Missing Score	0	0	0	0
Duplicates	0	0	0	0
No 8th Grade Scores	184	640	5,531	11,461
Regression Obs	3,024	4,327	41,133	655
Percent of Total Score Records	94.3%	87.1%	88.1%	5.4%

The most important thing to note from Table 3 is the fact that only a small percentage of grade-12 students could be included in the 2024 EOC growth models, as most of them did not have available grade-8 scores due to the lost year of

MAP testing in 2020 resulting from the pandemic.[9] This loss of prior test score data had the largest impact on the Government EOC exam, as 18% of the test takers in 2024 were grade-12 students. In comparison, only 8% of Algebra I students, 6% of Biology students, and 5% of English II students took the respective 2024 EOCs in grade 12. This suggests that the Government EOC growth measures are likely less reliable and less indicative of LEA and building-level instructional quality in this subject than they would be in a typical year. In addition, some LEAs and buildings do not have a reported Government EOC growth measure in 2024 due to a lack of useable student records. Fortunately, however, this is less of an issue this year than last year, when roughly two-thirds of Government EOC exam takers had to be excluded due to a lack of grade-8 MAP exam records.

More generally, the number of student exam records lost due to a lack of available previous test scores is unsurprisingly higher with the EOC growth models than with the standard grade-level assessments. For the grade-level assessments, roughly 95% of students with a grade-level assessment have an available prior year exam score and, thus, can be included in the GLA growth model. (The percentages vary from a low of 94.0% for grade-8 math to a high of 98.1% for grade-7 and grade-8 Algebra I.) The respective percentages for the EOC models are between 87-93% for grade-9 students, 87-92% for grade-10 students, and 74-88% for grade-11 students.

Last year, which was the first year EOC exams were officially incorporated into the growth modeling framework, the EOC exams were standardized separately by grade level, i.e., students who took the exam in grade-9 were standardized separately from those who took the same EOC in grade-10, and so on. This approach equalized the variance-weight of the exams across grade levels, ensuring that scores in different grades were given equal weight (on average) in the final subject-specific EOC growth measures. However, following discussions with SAS, in 2024 the EOC scores were standardized using the full population of high school students who took the exam, rather than separately by grade-level. This procedural change had minimal substantive effects on the growth measures and better facilitates longitudinal exam tracking visualizations in the data visualization tool (DVT). The means and standard deviations used to standardize the 2024 EOC exams are reported in Table 4.

Table 4: EOC Exam Means and Standard Deviations Used for Standardization

	N	Mean	St. Dev
Algebra I	59,075	394.01	12.21
Biology	67,888	393.40	17.18
English II	67,921	399.86	12.84
Government	66,955	396.73	16.70

Notes: The number of records reported in Table 4 is the sum of the by-grade total score records reported in Table 3 for each subject. The number of high school Algebra I takers is smaller than that of the other EOC exams because some students take the Algebra I EOC in seventh and eighth grade. These early Algebra I takers were not used in the standardization of the high school Algebra I exam scores.

[9] The small percentage of grade-12 students with available grade-8 MAP scores are likely students who did not graduate on time with their grade-8 cohort.

Regression Analyses

Turning to the first-stage regressions, Table 4 presents the R-squared values for each model. As with the grade-level assessments, the first-stage models are estimated separately by grade to allow for differing statistical relationships between the grade-8 exam scores and EOC exam scores taken at the different grade levels. This is particularly important for the EOC models given the differing gaps between the grade-8 previous exam scores and subsequent EOC taking. It also helps to account for selection effects related to the timing of when students take the exam.

Table 5: Percentage of the Variance in Student EOC Scores Explained by the First-Stage Regression Models

	Algebra I		Biology		English II		Government	
	N	R-Sq	N	R-Sq	N	R-Sq	N	R-Sq
Grade 9	34,083	0.551	18,072	0.727	738	0.665	3,024	0.714
Grade 10	12,171	0.524	31,518	0.664	56,528	0.569	4,237	0.612
Grade 11	3,498	0.276	8,663	0.654	1,717	0.444	41,133	0.565
Grade 12	266	0.317	340	0.492	244	0.374	655	0.542

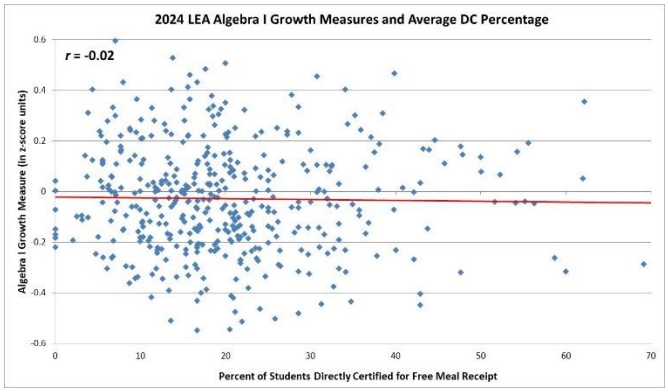
Overall, the first-stage R-squared values for the EOC growth models vary from a low of 0.276 (grade-11 Algebra I) to a high of 0.727 (grade-9 Biology). Comparing across subjects, model performance is strong in all grades for both Biology and Government, with R-squared values for the earlier grades in line with or even above what we observe in the traditional grade 4-8 GLA models and values for the later grades similar to those estimated in the grade 7 and grade 8 Algebra I models. In contrast, Algebra I shows the weakest performance, with R-squared values varying between 0.276 and 0.551, while English II falls somewhere in between, with strong performance in the grade-9 model that slowly declines to 0.374 by grade 12. In nearly every case, however, 2024 first-stage model performance was higher than in 2023, often by a sizeable margin, with grade-12 Biology being the lone exception.

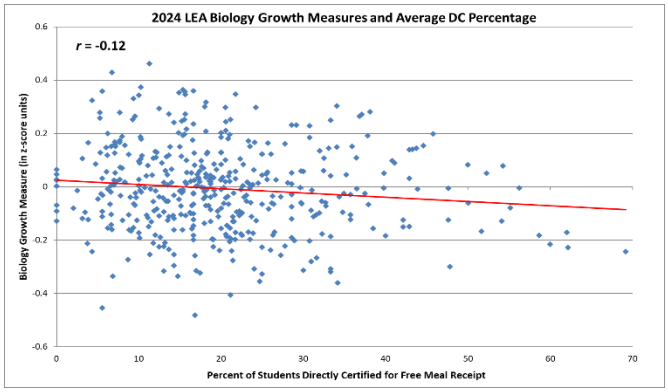
Given the complications associated with estimating EOC growth models, specifically the increasing gaps between the previous scores and the EOC score, the lack of a true, same-subject previous exam score on which to condition, and issues of selection effects on timing into the exams, some decline in the predictive ability of the first-stage regression is expected. Furthermore, the EOC exams appear to be less consistent from year to year than the GLA exams. That said, the first-stage R-squared values presented in Table 5 are sufficient to provide meaningful predicted values and subsequent growth measures, particularly give the improvements seen between 2023 and 2024.

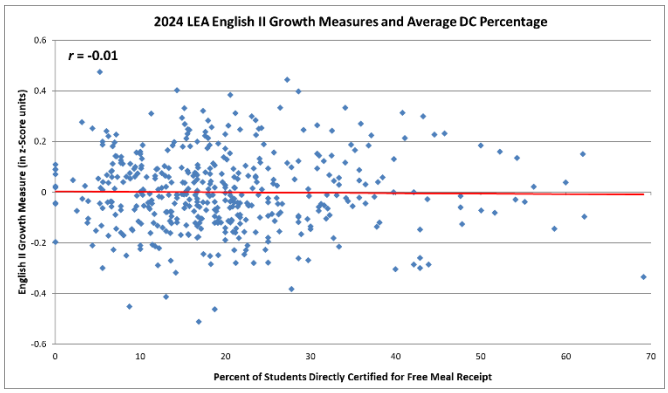
Summary of Growth Measures and Correlations

Figures 4-5 are parallel to Figures 2-3 and present LEA-level scatterplots for each of the four EOC growth measures described above plotted against LEA direct certification and underrepresented minority percentages.

Figure 4: Scatterplot of EOC Growth Measures and Share of Tested Students Directly Certified for Free Meal Receipt







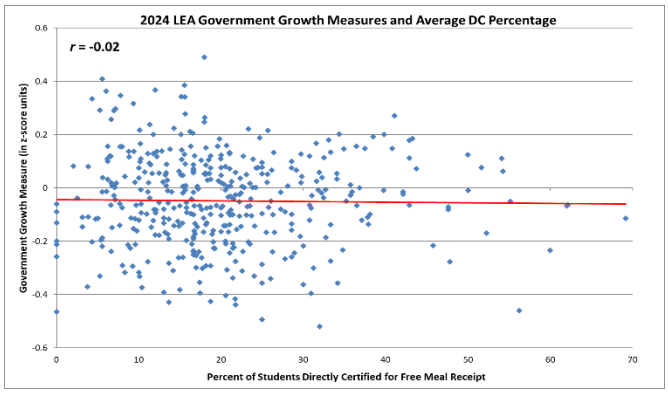
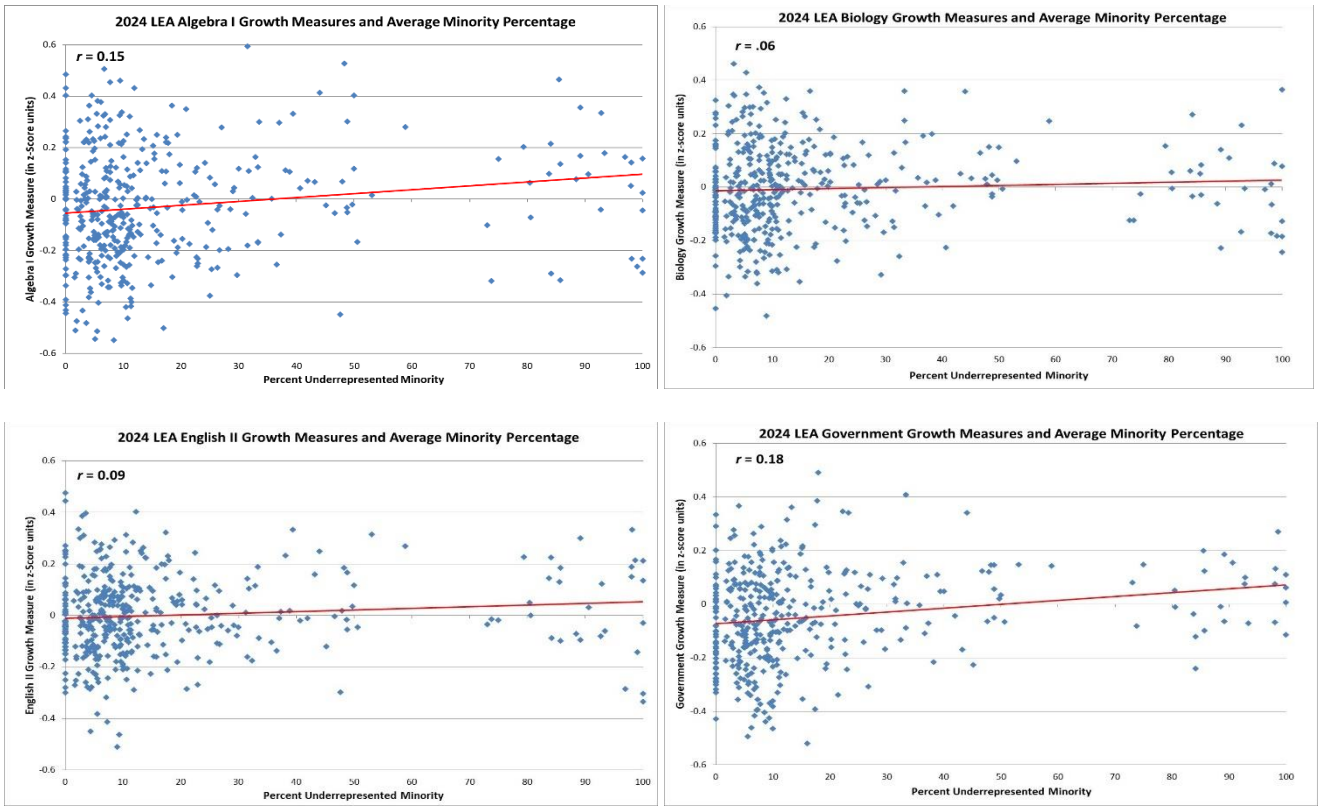


Figure 5: Scatterplot of EOC Growth Measures and Share of Tested Students in Underrepresented Minority Groups



As noted in the previous section, the first-stage predictive power of the EOC growth models is slightly below that for the traditional grade-level models. This has two potential impacts on growth model estimation. First, it introduces more noise into the growth estimates, as less of the exam score variation is explained by the included variables. The other potential impact of a weaker first-stage model occurs if the included predictor variables are no longer sufficient to control for the factors that are outside the LEA's and building's control, thus introducing some level of potential bias into the measure. Fortunately, there is little evidence of this in the above scatterplots. Most of the estimated correlations are small in magnitude, particularly with respect to direct certification percentage. Moreover, although the estimated correlations with respect to underrepresented minority percentage are a bit larger, on average, they are all positive, and positive correlations may be of less concern in the context of accountability system usage, as they are applied in concert with status measures that have a strong negative correlation with key measures of disadvantage. Also, it's worth noting that APR points for growth are awarded based on a combined growth score that is a student-weighted average of the GLA and EOC growth measures in a specific subject. This weighted aggregation mitigates the size of the demographic correlations reported above, particularly those for the EOC growth measures given their lower student counts. Scatterplots of the combined growth measures are reported in the next section.

3. Combined GLA/EOC Growth Measures (Grades 4-12)

Procedural Overview / Summary

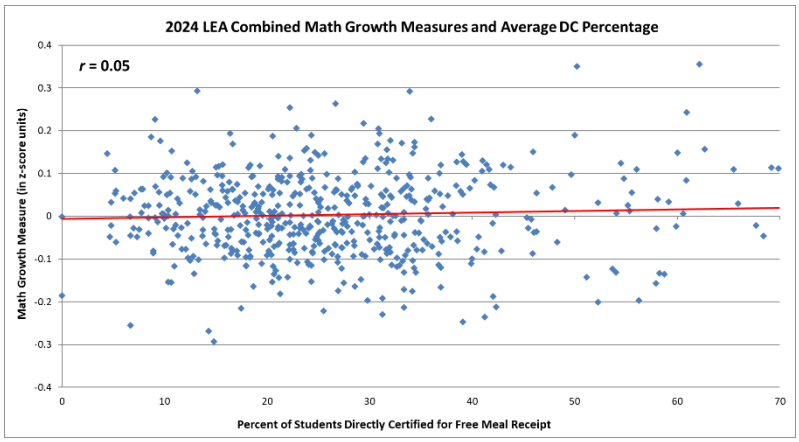
Starting in 2024, combined GLA/EOC growth measures were produced for mathematics, ELA, and science by calculating a weighted average of the GLA and EOC growth measures in the relevant subject, where the weights were given by the number of student residuals used in the calculation of each growth measure.[10] The number of residuals used in the calculation of each component is reported in Table 6 below. As noted above and illustrated in Figures 6 and 7, this moderates any correlations between the combined growth measures and LEA/building demographics.

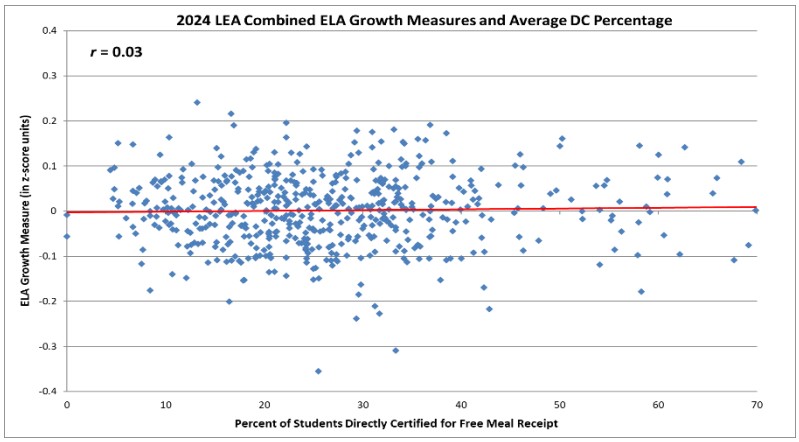
[10] No combined growth measure was produced for social studies, as there is not GLA MAP exam in that subject.

Table 6: Student Residual Counts for each Component of the Combined Growth Measures

	Total N	GLA	EOC
Mathematics	355,789	305,771	50,018
ELA	364,689	305,462	59,227
Science	181,705	123,112	58,593

Figure 6: Scatterplot of Combined GLA/EOC Growth and Share of Tested Students Directly Certified for Free Lunch





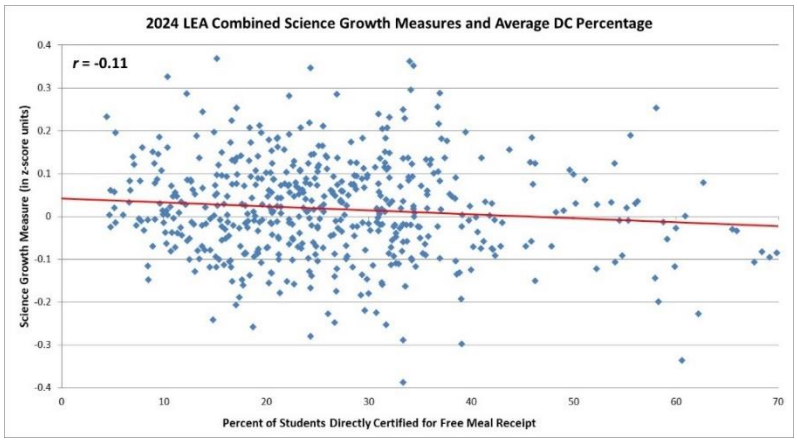
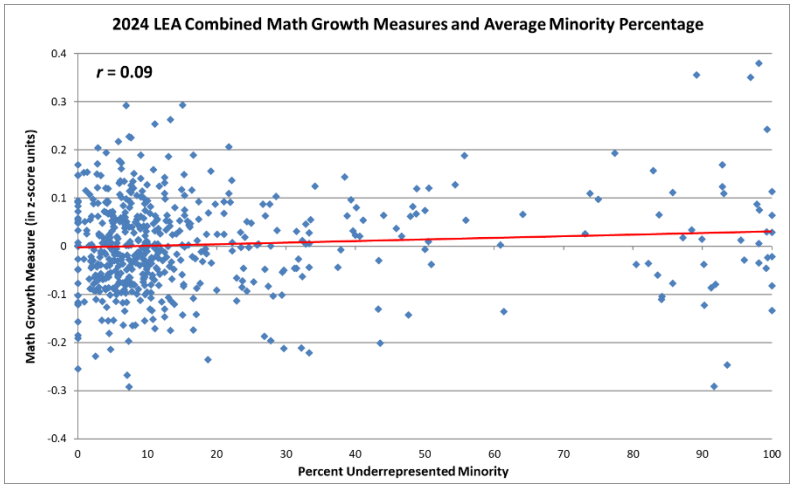
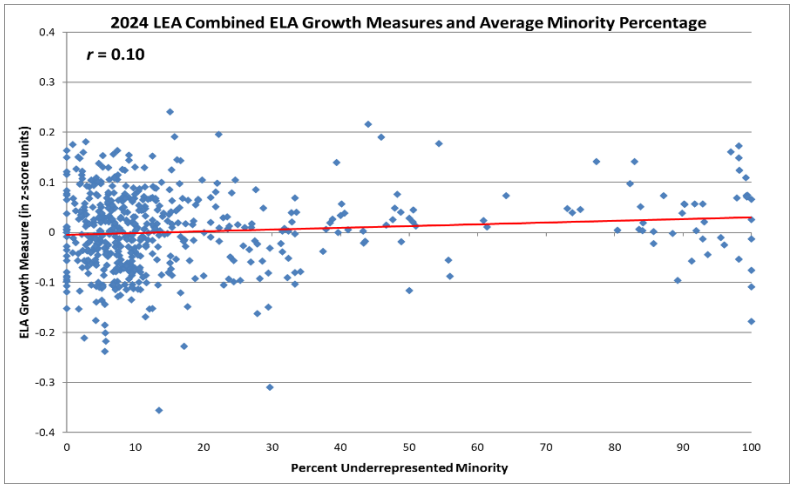
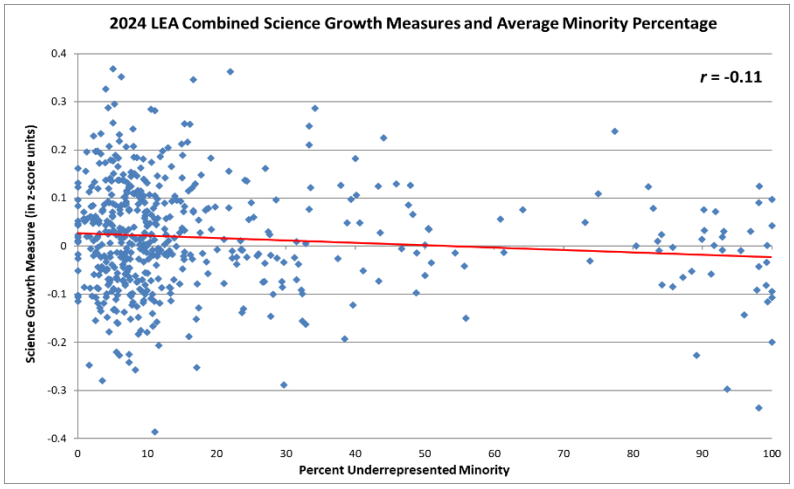


Figure 7: Scatterplot of Combined GLA/EOC Growth and Share of Tested Students in Underrepresented Minority Groups







4. Conclusions and Recommendations

A thorough review of the results and diagnostic analyses conducted on the 2024 Missouri Growth Model estimation process indicates that the Missouri Growth Model continues to perform well. As such, the growth measures remain informative about LEA and building contributions to student academic growth in Missouri over the past year.

Moving forward, the following represent the key revisions and considerations to be addressed in 2025:

1. The University of Missouri team will begin producing estimated student-level growth targets that can be used by LEAs as a student-tracking tool. This follows from preliminary work conducted in 2024 that was presented in the *Estimated Predicted MAP Exam Score Report* (07/01/2024).

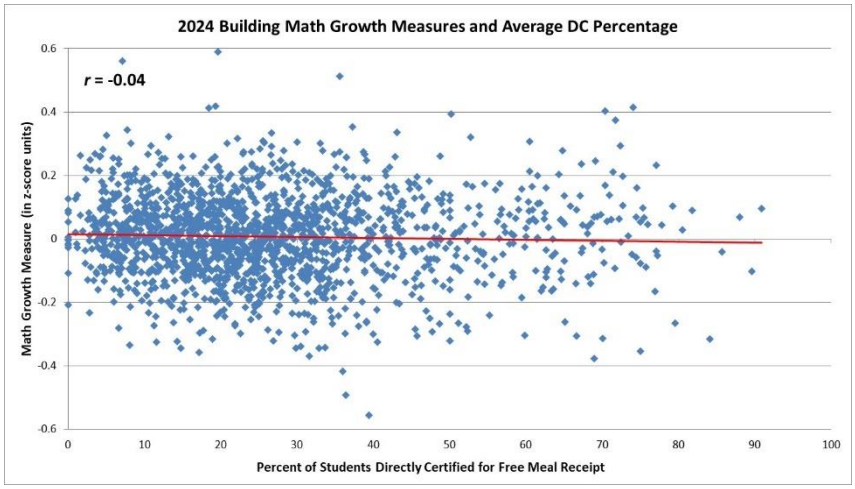
2. To enhance growth model performance, we plan to implement the following model refinements in 2025:

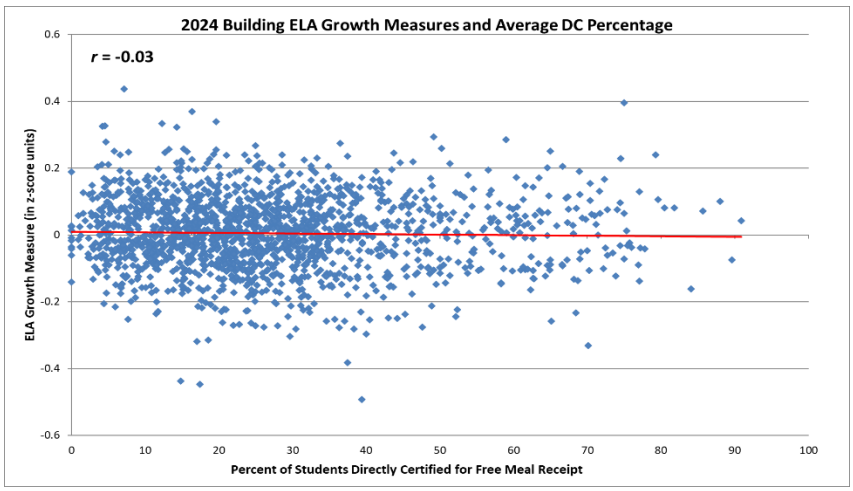
    a. Rather than entering the model as separate predictors in the first-stage regression of the EOC models, grade-8 mathematics and grade-8 Algebra I EOC scores will enter as a single prior mathematics exam score variable, where each student's entry will be determined by which of the two exam scores is available. In addition, a binary indicator variable will be added to indicate whether the prior mathematics exam score is the Algebra I EOC or the grade-8 mathematics exam. Further adjustments will be made to the missing exam score vector and interaction terms to account for this change.
    b. A data censoring rule based on an analysis of the student residuals produced by the GLA growth models will be applied to all student residuals.

3. The University of Missouri team will continue to monitor growth model performance to determine if any additional model refinements, such as those noted in point two above, are warranted. This monitoring is particularly important for the EOC growth models, as they are still in their early years of use and have more inherent variability than the traditional grade-level assessment models.

Appendix: Charts and Graphs for Building Level Growth Measures

Figure A.1: Scatterplot of GLA Growth Measures and Share of Tested Students Directly Certified for Free Lunch





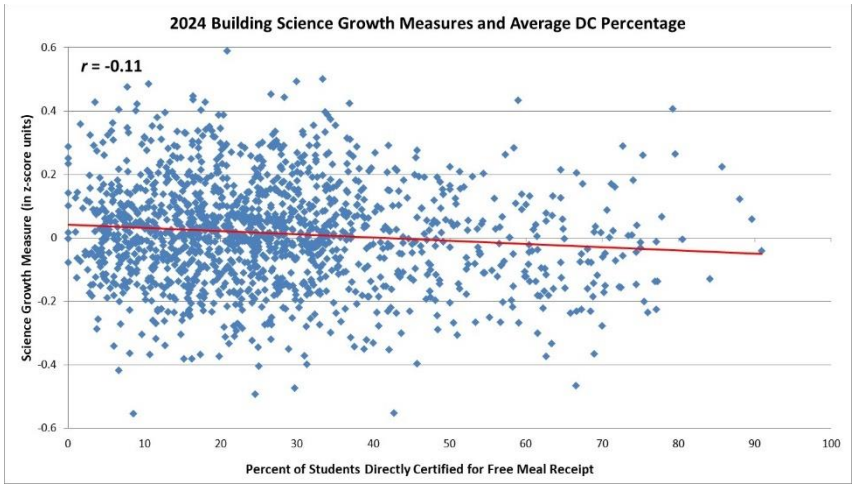
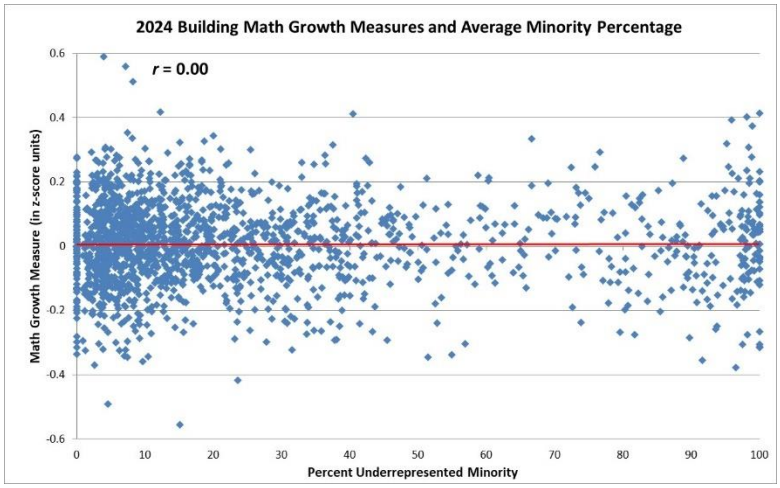
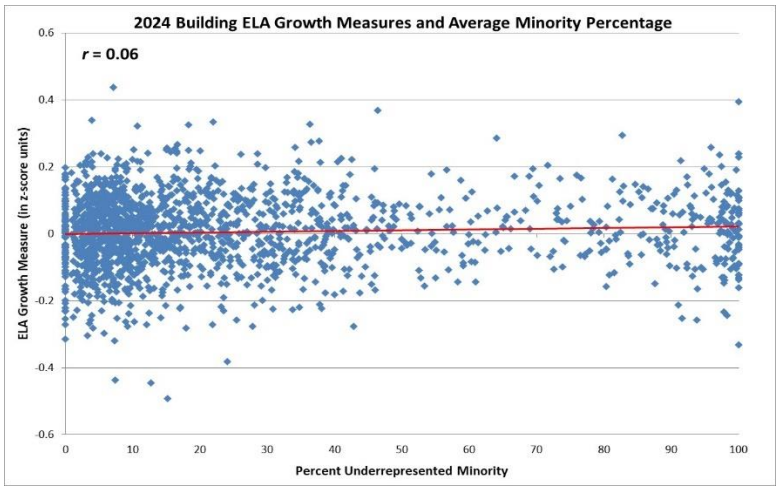


Figure A.2: Scatterplot of GLA Growth Measures and Share of Tested Students who are Members of Underrepresented Minority Groups





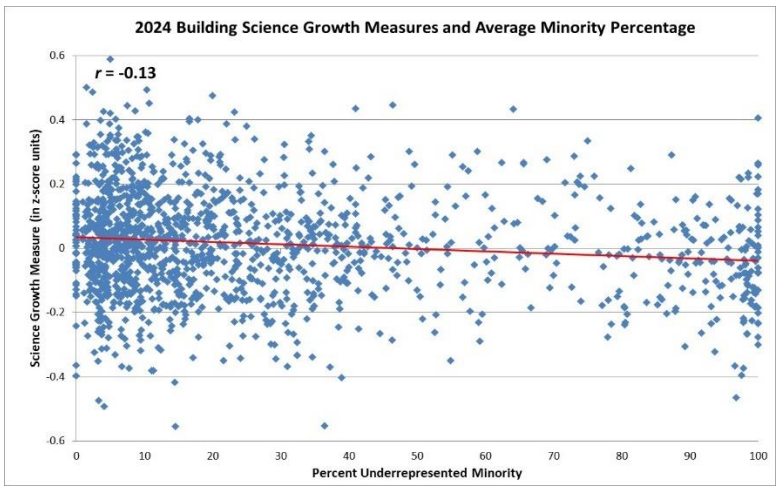


Figure A.3: Scatterplot of EOC Growth Measures and Share of Tested Students Directly Certified for Free Lunch

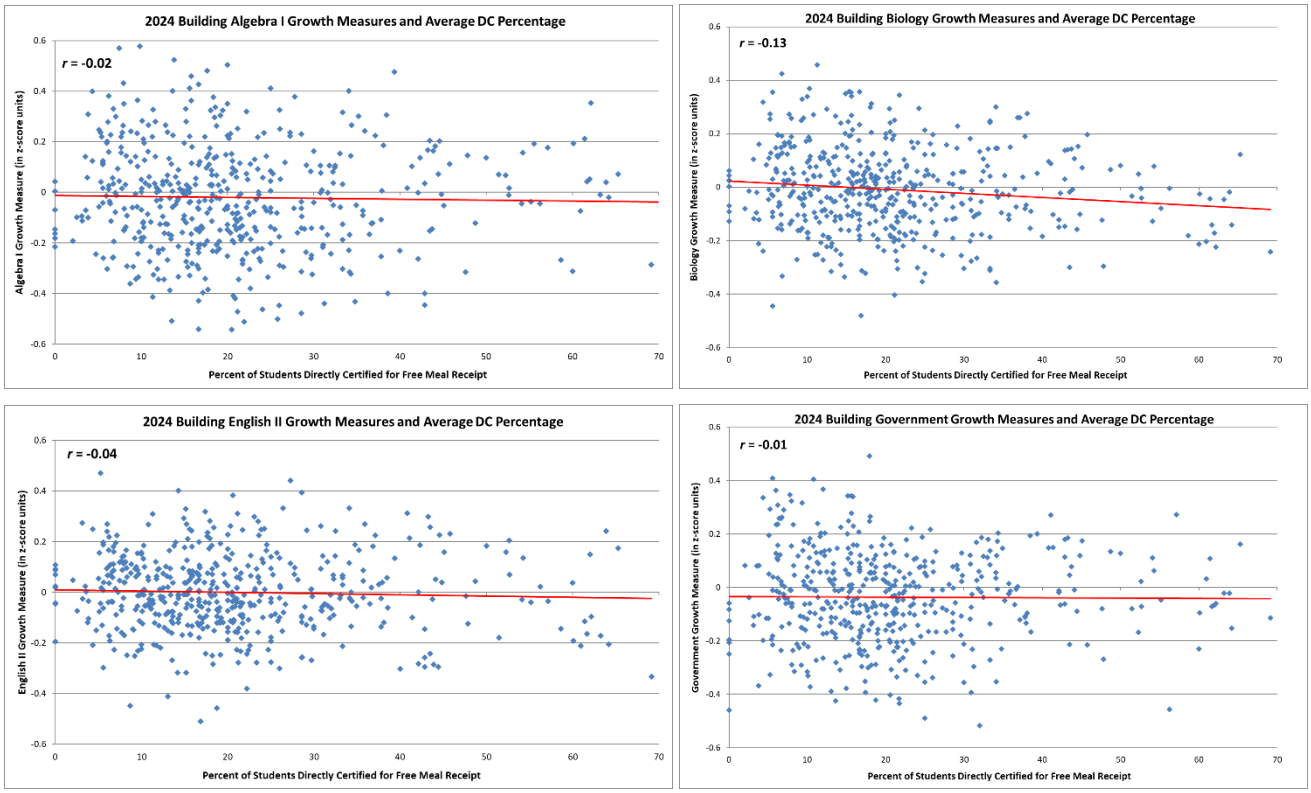


Figure A.4: Scatterplot of EOC Growth Measures and Share of Tested Students who are Members of Underrepresented Minority Groups