DELAWARE DEPARTMENT OF EDUCATION GROWTH MODEL INVESTIGATION:

A Report of the Growth Model Study Group

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EXECUTIVE SUMMARY

A 2023 group of district and school leaders and other education constituents convened by the Delaware Department of Education (DDOE) raised questions about the Delaware accountability system. They wondered whether the growth model was too highly related to achievement and, therefore, not rewarding schools for helping students grow even if the overall achievement was low.

Based on this feedback, Secretary Holodick and his leadership team convened a new technical group—a growth model study group—that included some of the 2023 members and many new members. The focus of the 2024 study group was to examine the quality of Delaware's growth indicator in the state's school accountability system.

The Delaware Department of Education convened the growth model study group to investigate whether the current Delaware growth model was working as intended and whether the model should be replaced with another growth model. The study group identified the following characteristics they wanted to see in a Delaware growth model.

- Growth should have a weak relationship to prior school-level achievement
- Growth should not favor high- or low-achieving schools
- The growth model should be technically strong
- The model should be explainable to non-technical audiences

After considerable discussion of multiple growth models, the study group identified four models for subsequent investigation: the current Delaware Growth Model, the Delaware Growth Model with updated growth targets, the Student Growth Percentile Model, and the Adequate Growth Percentile Model. These four student longitudinal growth models were analyzed extensively to help the study group weigh the models against the identified priorities.

The study group quickly ruled out the Adequate Growth Percentile Model because of the high correlations with prior achievement and how the model favors higher-achieving schools. The Student Growth Percentile Model also had unusually high correlations with prior achievement, but the study group continued to consider it because of its strong technical quality.

The current Delaware Growth Model and the Delaware Model with updated targets had the lowest relationships with school-level prior achievement. This is partly due to the slightly negative individual-level correlations between prior achievement and student growth. Nevertheless, these models are used in the aggregate as part of the school accountability system, and the aggregate relationships matter most.

While SGPs may have more well-documented technical qualities, the study group endorsed the Delaware Growth Model with the updated targets because of the advantage of the lower aggregate correlations. Additionally, the "cost" of changing models in terms of training and communication could be substantial. Therefore, the study group advocated for continuing to use the Delaware Growth Model in the school accountability system.

Even though the current model had slightly lower correlations between prior achievement and growth, the study group strongly agreed that the updated targets were more appropriate since the original targets were set in 2018. Furthermore, the study group suggested that the targets should be revisited every five years or so.

Finally, the study group believed that part of the challenges associated with the current growth model is due to the general lack of understanding of the model and how it works. Therefore, the study group requested that DDOE intensify its communication efforts to help the various constituents interpret and use the growth model results to support school improvement efforts.

BACKGROUND

During the spring of 2023, the Delaware Department of Education (DDOE) convened a group of district and school leaders and other education constituents to better understand Delaware's assessment and accountability system and provide input for additional investigations. That group affirmed the continued use of Smarter Balanced as the state assessment system. However, they raised concerns about the accountability system, particularly regarding whether the growth model was too highly related to achievement and, therefore, not rewarding schools for helping students grow even if the overall achievement was low.

The growth model study group was to examine the usefulness and quality of Delaware's growth indicator in the state's school accountability system. The National Center for the Improvement of Educational Assessment, Inc. (Center for Assessment) was contracted by DDOE to provide technical support to this group.

In this document, we review the study group's priorities, discuss the growth models considered, describe the analyses and results, and summarize the study group's feedback.

STUDY GROUP PROCESS

The study group was invited to meet five times from May through November 2024 to consider the characteristics of the State's current growth model and, if appropriate, provide feedback.

The group met in person for a full day for the first and last meetings. The second, third, and fourth meetings were virtual for 3 hours each. The study group was comprised of the following educational leaders:

MEMBER	POSITION	PLACE OF EMPLOYMENT
Sharon DiGirolamo	Superintendent	Seaford School District
Kelli Duncan	Data Coordinator	Cape Henlopen School District
Kelly Carvajal Hageman	Chief Academic Officer	Milford School District
LouAnn Hudson	Supervisor of Instructional Support	Cape Henlopen School District
April McCrae	Director of Assessment and Accountability	Delaware Department of Education
Hope Moffett	Supervisor of Accountability & Assessment	Brandywine School District
Jon Neubauer	Director, Education Policy	Delaware State Education Association
Adrian L. Peoples	Data Operations Officer	Delaware Department of Education
Michael Reitemeyer	Mathematics Supervisor	Las Aspira Americas Academy (LAAA) Charter School
Laura Saperstein	Education Associate, Accountability	Delaware Department of Education
Shawn Snyder	Director of Information Technology	Red Clay School District
Ned Southworth	Head of School	MOT Charter School
Sanford Student	Assistant Professor	University of Delaware
Courtney Voshell	Director - Teaching & Learning	Christina School District

The study group identified priorities and key characteristics they wanted to see in a growth model. Once the priorities were identified, the group explored potential growth models. We relied on Castellano and Ho's 2013 A Practitioner's to Growth Models to provide an overview of possible models.

The study group extensively discussed the various models presented in Castellano and Ho and the Delaware growth model. Several models were considered, but the study group rejected two for use in Delaware. Specifically, the group did not want to use a value-added model that adjusted for background factors (e.g., race and socioeconomic status) because of a worry about establishing differential expectations for different student groups. The study group also rejected value tables because they were concerned about the coarseness of distinctions.

However, the group explored several variations of the Student Growth Percentile Model and the Delaware Growth Model. As part of the discussion of the models, the study group specified the types of variations they wanted to see analyzed. In the summer of 2024, the Center for Assessment analyzed the multiple model variations and evaluated how the models compared based on the study group's priorities.

The study group considered the first round of analyses and requested that additional analyses be conducted for the fourth meeting. At the fourth meeting, the group examined the additional analyses and offered feedback regarding the growth model used in Delaware's school accountability system. During the last meeting, the study group reviewed this draft report and offered feedback.

GROWTH STUDY GROUP PRIORITIES FOR A GROWTH MODEL FOR DELAWARE'S ACCOUNTABILITY SYSTEM

The growth study group articulated several priorities and other considerations for a growth model.

Growth should have a weak relationship to prior school-level achievement. Most study group members indicated that a school's growth indicator should have no more than a weak relationship with aggregate (school-level) prior achievement. The rationale for this priority is that growth should contribute information that is at least partially independent of the information provided by achievement to give a more complete picture of school quality. In an accountability system, the independence of information is assessed contemporaneously. Thus, the analysis should also examine the relationship between the school-level growth and achievement indicators for the same year. By definition, student longitudinal growth will have a stronger relationship with current compared to prior-year growth. Still, the relationship with aggregate prior achievement should allow us to evaluate the relative independence of these two indicators.

Growth should not favor high- or low-achieving schools. Study group members preferred a model that does not award higher growth index scores to schools with high or low achievement scores. Not favoring either of these two kinds of schools is a particular case of the study group's first priority.

The growth model should be technically strong. Study group members favored a model with good evidence supporting its validity in accountability contexts.

The model should be explainable to non-technical audiences. The study group prioritized a growth model that could be explained to non-technical audiences while trying to reduce possibilities for misinterpretation.

Other considerations raised by the study group, focused on Delaware's existing model, included:

1. Acknowledging or rewarding growth across bins
2. Removing the 110-point cap on student percent of growth target attained (PGTA)
3. Revising growth targets to be more relevant or accurate
4. Using multiple prior scores instead of just one

MODELS TO STUDY

In response to the study group's priorities and in-depth discussion of several growth models, we studied two major growth model categories. These models include a variation of the current model and two variations of a Student Growth Percentile (SGP) model. The models reflect the study group's priorities and the additional considerations raised by the group. One of the models–a standard SGP model–does not incorporate growth targets into the computation of growth; however, all other models incorporate growth targets. All models revise growth targets based on the most recent available assessment years (2022 and 2023) and remove the upper and lower quartile average PGTA components of the school-level growth index. (Removing the cap on PGTA was planned for one of the models, but it resulted in highly skewed growth index distributions, as discussed in the study.) None of the models incorporate multiple priors of achievement due to the availability of only two years of recent data.

We describe the models below.

1. **Delaware modified gain scores model (the current model).** The current model can serve as a baseline against which to compare other models. Delaware's current growth model is a modified gain score model. The State calculates a student's gain score, transforms it to have a minimum of 0, divides the gain score by a growth target, and multiplies the result by 100%, which is then capped at 110%. The result is a student's percent of growth target achieved (PGTA). A student's growth target depends on their prior achievement. There are eight bins for growth targets, set so that four primary bins are defined by the Smarter Balanced achievement levels, each of which is subdivided further to span equal scale score intervals. The growth targets were defined as the by-bin 60th percentile from 2016 to 2017. A school's growth index is computed as 75% of the school's average PGTA plus 12.5% of the average PGTA of students in the lowest quartile of prior achievement plus 12.5% average PGTA of students in the upper quartile of prior achievement, capped at 100% after summing.
2. **Updated DE modified gain scores model.** The updated modified gain scores model attempted to incorporate three changes to the current DE model. The first change—removing the 110% PGTA cap[1]—proved unworkable. The second planned (and implemented) change was to recompute the model using growth targets estimated with data from 2022 to 2023. The third change was that the school's growth index was computed as the average of its students' PGTAs.

[1] Note: Variations of Model 2 were created and explored during the analyses because removing the cap on student PGTA resulted in highly skewed, low-variance student-level PGTA and school-level growth index distributions. For model evaluation purposes, we chose a variation of Model 2 that retained the cap on student PGTA.

3. **Student growth percentile (SGPs) with no growth targets.** The third proposed model is an SGP model, baselined to 2022-to-2023 growth[2] with no growth targets. In this model, a student's SGP serves as a student's growth score, and the mean SGP of its students serves as a school's growth index.

4. **SGPs with growth-to-standard targets.** One way to develop a growth target is to quantify, for each student, how much growth they need to reach proficiency in a certain number of years or by a certain grade, known as "growth to standard" targets. These are called adequate growth percentiles, or AGPs. The fourth model is an SGP model with AGPs as growth targets. Using 2022-2023 data, the AGPs are set as the SGP needed for the student, within 3 years, to reach level 3 ("catch up"), or level 4 if already at level 3 ("move up"), or to remain at level 4 if already at level 4 ("keep up"). Each student will have an SGP and an AGP. If a student's SGP is equal to or greater than their AGP, they are making adequate progress. Thus, a school's growth index can be computed as the percentage of its students making adequate progress.

We summarize model features in the table below.

Table 1. Summary of Growth Model Features

MODEL		GROWTH BINS	GROWTH TARGETS	STUDENT LEVEL GROWTH (FOR ACCOUNTABILITY)	SCHOOL GROWTH INDEX
1	Current	Eight, with four primary bins defined by achievement level, each subdivided further to span equal scale score intervals	Set at the 60th percentile of by-bin growth from 2016 to 2017	Percent of Growth Target Achieved (PGTA): Gain scores with negatives converted to zero, divided by the growth target, times 100%, capped at 110%	75% of the school's average PGTA plus 12.5% of the average PGTA of students in the lowest quartile of prior achievement plus 12.5% of the average PGTA of students in the upper quartile of prior achievement, capped at 100% after summing
2*	Current, updated	Eight, with four major bins defined by achievement level, each subdivided further to span equal scale score intervals	Set at the 60th percentile of by-bin growth from 2022 to 2023	PGTA*: Gain scores with negatives converted to zero, divided by the growth target, times 100%	The school's average PGTA, capped at 100%

[2] The SGP functional relationship will be estimated using 2022-to-2023 growth. Should this model be adopted, we propose using that relationship (or a more recent version, such as one estimated using 2023-to-2024 growth) as a baseline going forward.

3	SGPs, no growth targets	No bins - prior achievement (in 2022) treated as continuous	None	A student's SGP	A school's mean SGP
4	SGPs, growth-to-standard growth targets	No bins - prior achievement (in 2022) treated as continuous	Adequate Growth Percentile (AGP): Set as the SGP needed for: (A) Students at levels 1 or 2 to reach level 3 within three years. (B) Students at level 3 to reach level 4 within three years. (C) Students at level 4 to maintain level 4 three years from now.	1 if the student's SGP is equal to or greater than their AGP; 0 otherwise	Percent of students whose SGP is equal to or greater than their AGP

*Note: Variations of Model 2 were created and explored during the analyses because removing the cap on student PGTA resulted in highly skewed, low-variance student-level PGTA and school-level growth index distributions. For model evaluation purposes, we chose a variation of Model 2 that retained the cap on student PGTA.

EVALUATION METRICS

As planned, we employed four evaluation metrics, as described in the table below, to assess the degree to which the models empirically reflect the study group's priorities.

Table 2. Evaluation Metrics

	MODEL			
Metric	1	2	3	4
School-level correlation of growth and achievement.				
School-level correlation of growth and prior achievement.				
Growth index mean for schools in the lower quartile of achievement versus the upper quartile.				
Growth index mean for schools in the lower quartile of prior achievement versus the upper quartile.				

At the school level, growth should correlate weakly with current and prior achievement. The correlations of growth with achievement and growth with prior achievement will be assessed using the Pearson correlation coefficient and the Spearman rank correlation for both ELA and mathematics. Correlation coefficients describe the association between two variables. The Pearson correlation is used when the variables are normally distributed and are linearly related. Spearman simply examines the associated rank ordering across two variables. Values range between -1 (perfect inverse relationship) to 1 (perfect direct relationship), with a value of 0 indicating no association. We will also show scatterplots. In addition, basic descriptives of growth measures will be computed and reported.

As planned, we computed and provided:

1. The means, medians, standard deviations, minima, and maxima of the ELA and Math growth indices for the model being studied.
2. Boxplots of the ELA and Math growth indices.
3. The Pearson and Spearman correlations for (a) the ELA percent proficient indicator and the ELA growth indicator and (b) the Math percent proficient indicator and the Math growth indicator. We will compute the correlations of growth with contemporaneous achievement (for the achievement indicator of the same year) and with prior achievement.
4. Scatterplots of the above.

Per the study group's priorities, the growth model should not favor lower- or higher-performing schools.

Thus, we provided:

1. Boxplots of the ELA growth index computed for each quartile of the school-level ELA and Math proficiency indicators.
2. Means of the ELA growth index by quartile of school-level ELA and Math proficiency indicators (both contemporaneous and prior).

DESCRIPTIVES AND ADDITIONAL ANALYSES FOR MODEL 2

In addition to the above evaluation metrics, we provided descriptive statistics and displays for the school-level percent proficiency indicators for 2022 and 2023. These descriptives apply to all models. These descriptives include

1. The means, medians, standard deviations, minimum, and maximum of the ELA and Math percent proficient indicators.
2. Boxplots of the percent proficient indicators.
3. Intercorrelations among the proficiency indicators, both Pearson and Spearman.
4. Scatterplots across all combinations of the percent proficient indicators.

These descriptives are in Appendix 1.

The analyses for Model 2 included

1. Counts of growth-eligible students by grade and bin.
2. Updated growth targets.
3. A bin-by-bin comparison of the updated and current growth targets.
4. An analysis of results using capped versus uncapped versions of PGTA.

These additional analyses are reported in Appendix 2.

ANALYSIS RESULTS

In this section, we present the results of our planned analysis, model by model. The distributions of–and interrelationships among–proficiency indicators are presented in Appendix 1.

Model 1. DE modified gain scores model (the current model)

Table 3 and Figure 1 below describe the distributions of school-level growth indicators for Delaware's current growth model, Model 1.

Table 3. Descriptives of Growth Indicators, Model 1

						PERCENTILES				
Growth Index	Count	Mean	SD	Min	Max	10	25	50	75	90
ELA	153	57.6	9.2	27.2	79.2	47.2	52.3	58.5	62.6	69.7
Math	153	60.8	11.3	37.5	92.7	46.2	52.7	59.7	68.5	77.2

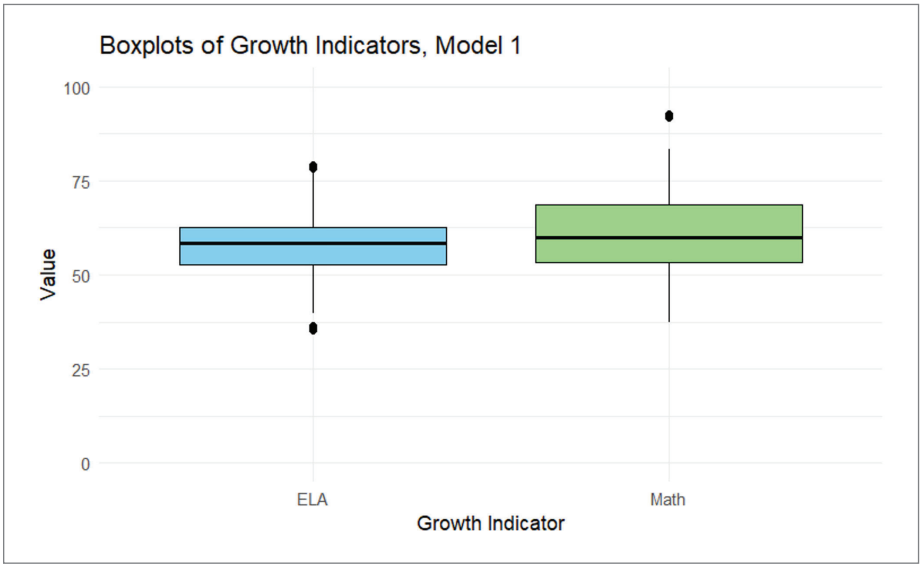

Figure 1. Boxplots of growth indicators, Model 1.

As shown in Table 4 and Figure 2, the (Pearson) correlations between 2022-to-2023 growth and 2022 proficiency are .32 (ELA) and .42 (math). The patterns of the Pearson and Spearman correlation coefficients are similar. There is a large correlation between growth across the two content areas (.75).

Table 4. Correlations among School-level Proficiency and Model 1 Growth Indices

	Proficiency ELA 2023	Proficiency Math 2023	Proficiency ELA 2022	Proficiency Math 2022	Growth ELA	Growth Math
Proficiency ELA 2023		0.92	0.97	0.93	0.41	0.33
Proficiency Math 2023	0.93		0.89	0.97	0.5	0.52
Proficiency ELA 2022	0.96	0.9		0.93	0.32	0.26
Proficiency Math 2022	0.94	0.97	0.93		0.45	0.42
Growth ELA	0.42	0.51	0.31	0.46		0.75
Growth Math	0.36	0.54	0.28	0.45	0.76	

Note: Correlations are Pearson (upper triangle) and Spearman (lower)

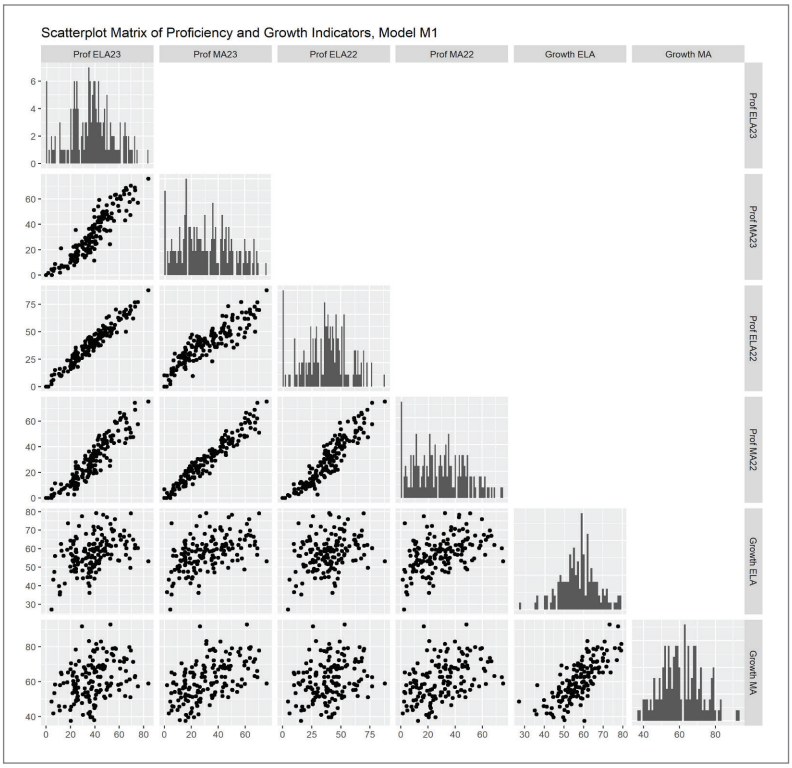

Figure 2. Scatterplot matrix of proficiency and growth indicators, Model 1.

Growth index by quartile of proficiency indicator

This section displays growth separately by quartile of the school-level proficiency indicator. We present the results in two ways – first by quartile of current proficiency and next by prior proficiency. The trends of means across these quartiles reflect the correlations between growth indices and proficiency indicators.

The results in the following tables and figures, showing increases in growth by proficiency indicator, are consistent with the correlations between growth and proficiency for Model 1.

By quartile of current (2023) proficiency

Table 5. Descriptives of ELA Growth Index by Quartile of Current Proficiency, Model 1

	MODEL 1 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2023	53.3	55.3	10.0	27.2	73.7
Q2 ELA Proficiency 2023	53.8	53.2	8.3	36.1	77.5
Q3 ELA Proficiency 2023	60.1	59.4	8.1	43.8	79.2
Q4 ELA Proficiency 2023	63.1	62.0	6.8	49.6	79.0

Table 6. Descriptives of Math Growth Index by Quartile of Current Proficiency, Model 1

	MODEL 1 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2023	54.5	55.1	7.9	38.0	70.5
Q2 Math Proficiency 2023	55.2	53.8	11.0	37.5	91.6
Q3 Math Proficiency 2023	64.8	65.3	9.7	46.5	83.2
Q4 Math Proficiency 2023	68.5	69.1	9.4	51.0	92.7

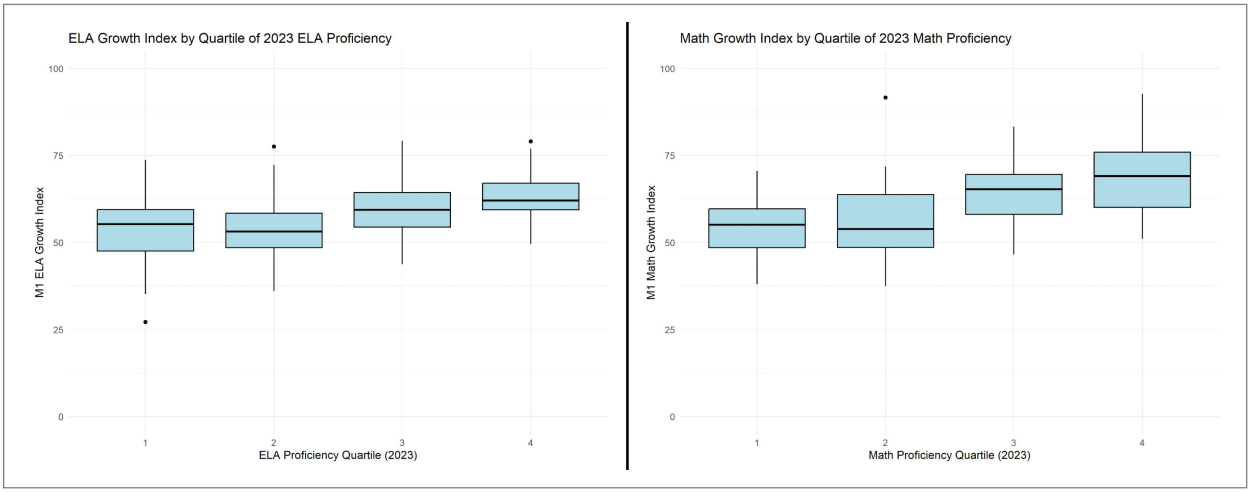

Figure 3. Boxplots of growth by quartile of current proficiency, Model 1.

By quartile of prior (2022) proficiency

Table 7. Descriptives of ELA Growth Index by Quartile of Prior Proficiency, Model 1

	MODEL 1 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2022	54.1	56.1	10.9	27.2	73.7
Q2 ELA Proficiency 2022	56.2	55.2	7.3	44.1	77.5
Q3 ELA Proficiency 2022	57.3	58.5	10.0	36.1	79.2
Q4 ELA Proficiency 2022	62.5	61.9	6.8	49.6	79.0

Table 8. Descriptives of Math Growth Index by Quartile of Prior Proficiency, Model 1

	MODEL 1 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2022	54.8	55.6	8.4	37.5	70.5
Q2 Math Proficiency 2022	57.6	55.4	12.4	39.5	91.6
Q3 Math Proficiency 2022	63.2	62.8	9.7	46.5	83.0
Q4 Math Proficiency 2022	67.6	68.6	9.1	51.0	92.7

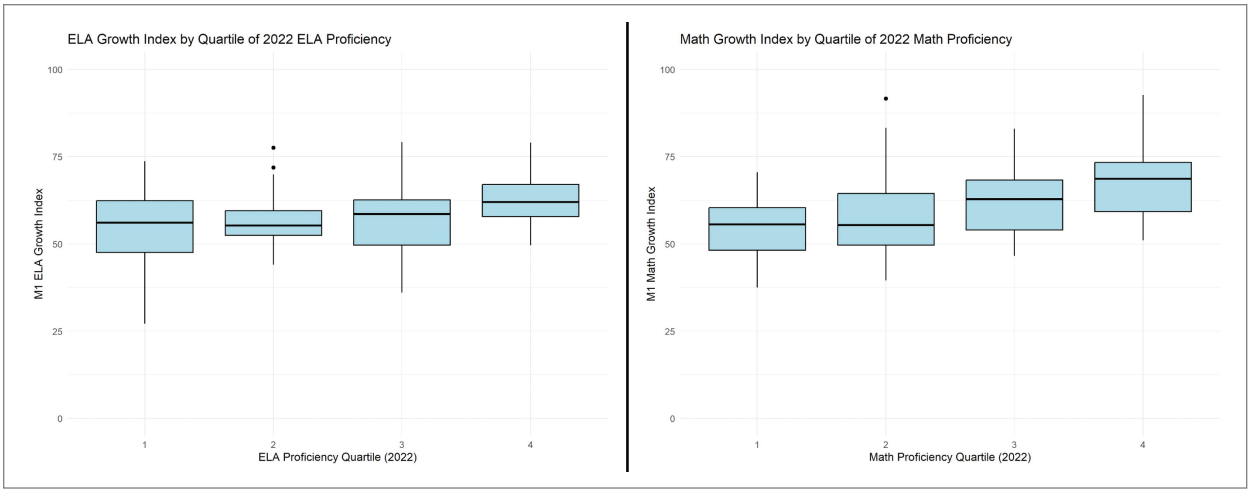

Figure 4. Boxplots of growth by quartile of prior proficiency, Model 1.

Model 2. Updated DE modified gain scores model

Among the school-level growth indices reviewed, only the mean-defined school-level growth indices for capped PGTAs had reasonable distributions. Thus, we report on the growth indices based on this variation of Model 2.

Additional analyses relevant to Model 2 are reported in Appendix 2. The appendix discusses different variations of Model 2, school-level growth index distributions under those variations, the results of resetting growth targets using 2022-to-2023 gains, and the differences between the updated and current growth targets.

Table 9 and Figure 5 present the distributions of school-level growth indicators for the modified gain scores model, Model 2.

Table 9. Descriptives of Growth Indicators, Model 2 (mean-defined, capped variation)

						PERCENTILES				
Growth Index	Count	Mean	SD	Min	Max	10	25	50	75	90
ELA	153	57.7	9.0	28.4	78.4	47.4	52.4	57.8	63.2	69.8
Math	153	60.0	10.8	34.8	91.5	46.1	52.7	59.4	66.9	75.1

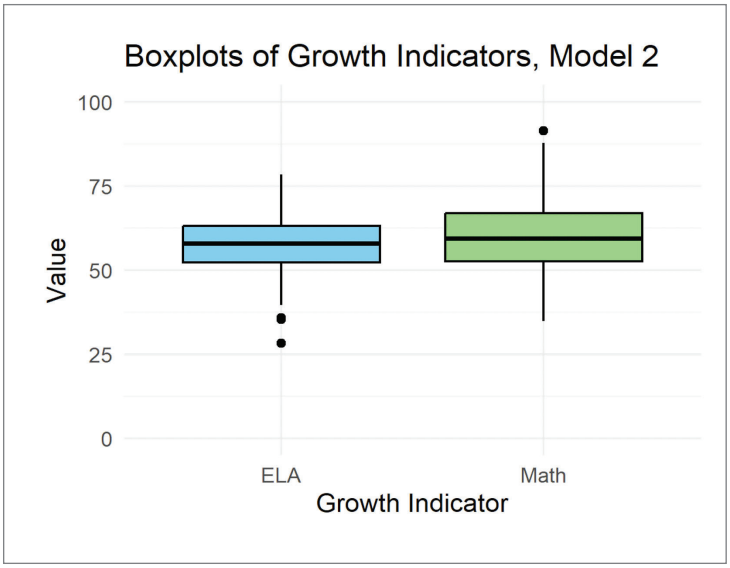

Figure 5. Boxplots of growth indicators, Model 2.

As shown in Table 10 and Figure 6, the (Pearson) correlations between 2022-to-2023 growth and 2022 proficiency are .40 (ELA) and .52 (math), slightly higher than for Model 1. There is a large correlation between growth across the two content areas (.76), comparable to Model 1.

Table 10. Correlations among School-level Proficiency and Model 2 Growth Indices

	Proficiency ELA 2023	Proficiency Math 2023	Proficiency ELA 2022	Proficiency Math 2022	Growth ELA	Growth Math
Proficiency ELA 2023		0.92	0.97	0.93	0.50	0.45
Proficiency Math 2023	0.93		0.89	0.97	0.56	0.62
Proficiency ELA 2022	0.96	0.90		0.93	**0.40**	0.39
Proficiency Math 2022	0.94	0.97	0.93		0.50	**0.52**
Growth ELA	0.51	0.57	0.39	0.52		0.76
Growth Math	0.49	0.64	0.40	0.55	0.75	

Note: Correlations are Pearson (upper triangle) and Spearman (lower)

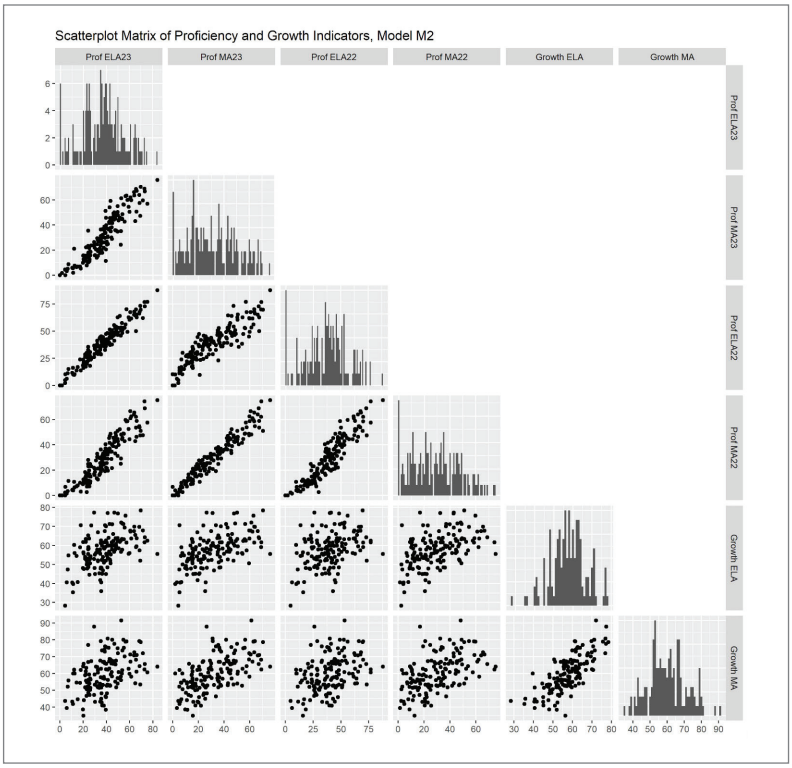

Figure 6. Scatterplot matrix of proficiency and growth indicators, Model 2.

Growth index by quartile of proficiency indicator

This section displays growth separately by quartile of school-level proficiency. We present the results in two ways – first by quartile of current proficiency and next by quartile of prior proficiency. The trends of means across these quartiles reflect the correlations between growth indices and proficiency indicators.

The results in the following tables and figures, showing increases in growth by proficiency indicator, are consistent with the correlations between growth and proficiency for Model 2.

By quartile of current (2023) proficiency

Table 11. Descriptives of ELA Growth Index by Quartile of Current Proficiency, Model 2

	MODEL 2 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2023	52.5	53.9	9.2	28.4	70.7
Q2 ELA Proficiency 2023	53.6	53.0	7.9	35.9	77.3
Q3 ELA Proficiency 2023	60.1	59.8	7.4	45.0	77.3
Q4 ELA Proficiency 2023	64.0	63.3	6.2	52.0	78.4

Table 12. Descriptives of Math Growth Index by Quartile of Current Proficiency, Model 2

	MODEL 2 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2023	52.2	54.0	7.5	38.4	65.7
Q2 Math Proficiency 2023	54.7	53.3	9.5	34.8	87.9
Q3 Math Proficiency 2023	63.9	62.9	8.7	46.4	80.7
Q4 Math Proficiency 2023	68.6	68.2	8.6	52.6	91.5

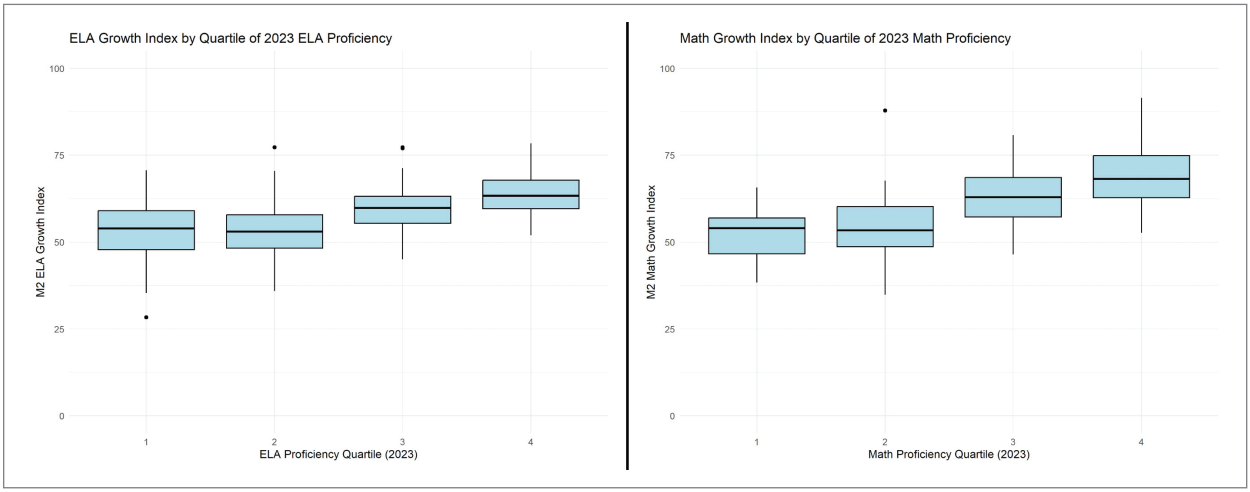

Figure 7. Boxplots of growth by quartile of current proficiency, Model 2.

By quartile of prior (2022) proficiency

Table 13. Descriptives of ELA Growth Index by Quartile of Prior Proficiency, Model 2

	MODEL 2 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2022	53.4	54.6	10.1	28.4	70.7
Q2 ELA Proficiency 2022	56.2	55.5	6.9	44.6	77.3
Q3 ELA Proficiency 2022	57.2	57.8	9.6	35.9	77.3
Q4 ELA Proficiency 2022	63.4	63.2	6.3	52.0	78.4

Table 14. Descriptives of Math Growth Index by Quartile of Prior Proficiency, Model 2

	MODEL 2 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2022	52.5	54.2	8.1	34.8	65.7
Q2 Math Proficiency 2022	56.9	55.9	10.9	40.9	87.9
Q3 Math Proficiency 2022	62.3	61.5	9.0	46.4	80.7
Q4 Math Proficiency 2022	67.7	67.2	8.4	53.0	91.5

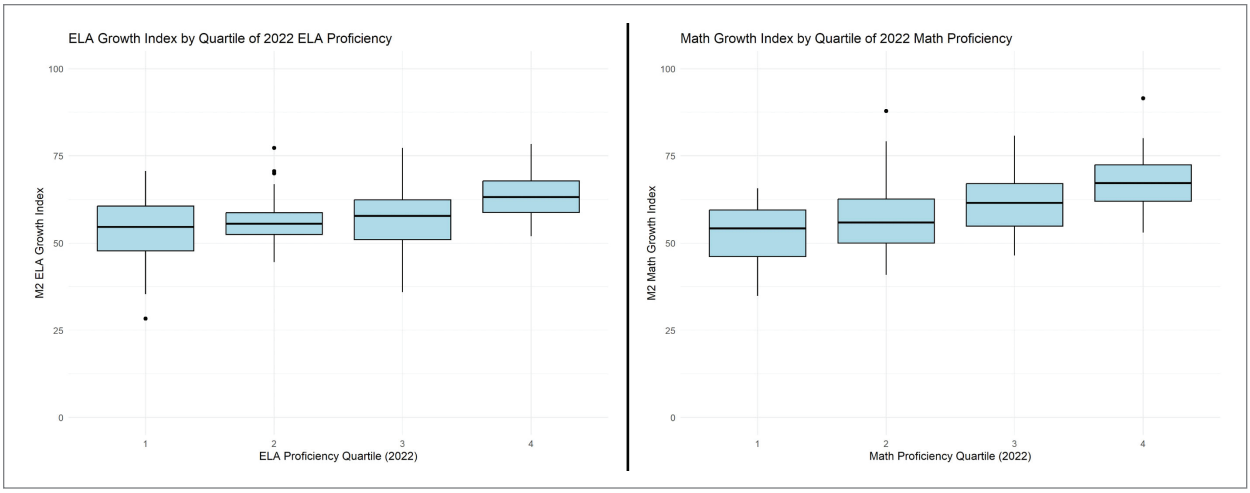

Figure 8. Boxplots of growth by quartile of prior proficiency, Model 2.

Model 3. The student growth percentiles (SGP) model

Table 15 and Figure 9 below describe the distributions of school-level growth indicators for Model 3, the student growth percentiles (SGP) model.

Table 15. Descriptives of Growth Indicators, Model 3

						PERCENTILES				
Growth Index	Count	Mean	SD	Min	Max	10	25	50	75	90
ELA	153	49.6	6.0	26.8	63.8	42.5	45.5	49.4	53.6	56.7
Math	153	49.7	7.0	27.6	70.2	41.8	45.1	49.8	53.1	58.3

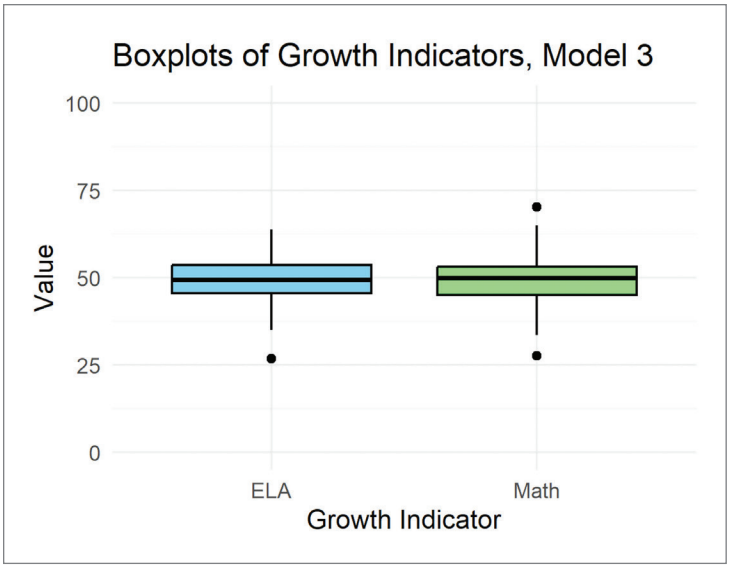

Figure 9. Boxplots of growth indicators, Model 3.

Note that although SGPs are defined so that (for a baseline year) the mean SGP is 50, this need not be the case for the mean of school mean SGPs, which is what the above table and figure show. Nonetheless, the mean and medians of school mean SGPs are close to 50.

As shown in Table 16 and Figure 10, the (Pearson) correlations between 2022-to-2023 growth and 2022 proficiency are .62 (ELA) and .55 (math), which are larger than Models 1 and 2. There is a large correlation between growth across the two content areas (.78), comparable to Models 1 and 2.

Table 16. Correlations among School-level Proficiency and Model 3 Growth Indices

	Proficiency ELA 2023	Proficiency Math 2023	Proficiency ELA 2022	Proficiency Math 2022	Growth ELA	Growth Math
Proficiency ELA 2023		0.92	0.97	0.93	0.71	0.60
Proficiency Math 2023	0.93		0.89	0.97	0.65	0.64
Proficiency ELA 2022	0.96	0.90		0.93	0.62	0.54
Proficiency Math 2022	0.94	0.97	0.93		0.61	0.55
Growth ELA	0.70	0.64	0.59	0.60		0.78
Growth Math	0.61	0.65	0.53	0.56	0.76	

Note: Correlations are Pearson (upper triangle) and Spearman (lower)

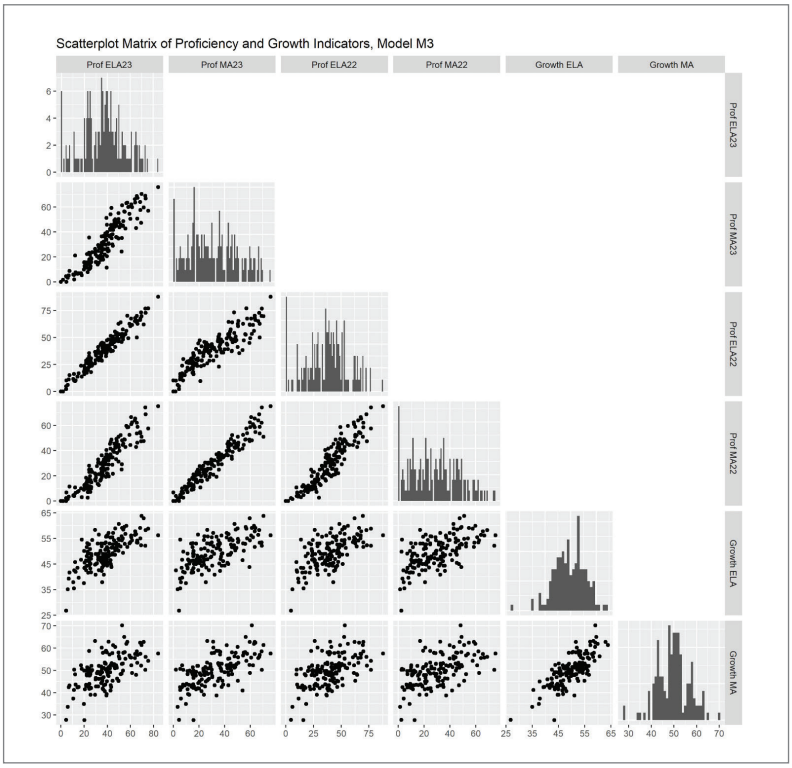

Figure 10. Scatterplot matrix of proficiency and growth indicators, Model 3.

Growth index by quartile of proficiency indicator

As with the other models, the trends of the growth indices across quartiles of current and prior proficiency reflect the correlations between the growth indices and proficiency indicators, as shown in the tables and figures below.

By quartile of current (2023) proficiency

Table 17. Descriptives of ELA Growth Index by Quartile of Current Proficiency, Model 3

	MODEL 3 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2023	44.3	45.5	5.8	26.8	54.5
Q2 ELA Proficiency 2023	47.3	47.0	4.4	37.9	58.3
Q3 ELA Proficiency 2023	50.6	50.5	4.1	43.8	58.9
Q4 ELA Proficiency 2023	55.5	54.9	3.4	49.4	63.8

Table 18. Descriptives of Math Growth Index by Quartile of Current Proficiency, Model 3

	MODEL 3 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2023	44.1	43.5	5.6	27.7	52.3
Q2 Math Proficiency 2023	47.2	48.2	5.4	27.6	63.2
Q3 Math Proficiency 2023	51.4	51.1	5.6	38.6	62.8
Q4 Math Proficiency 2023	55.9	56.3	5.6	40.9	70.2

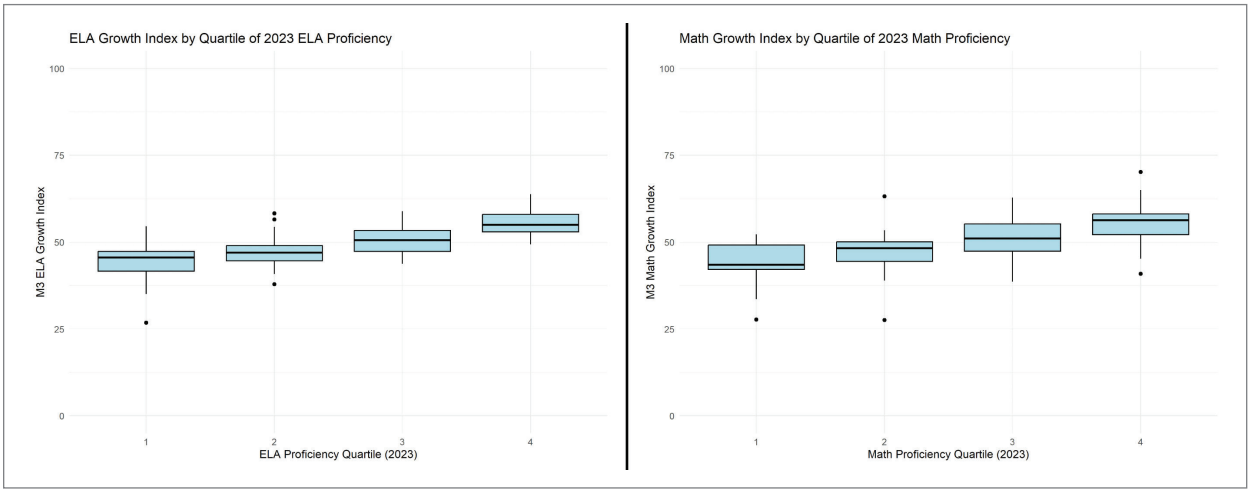

Figure 11. Boxplots of growth by quartile of current proficiency, Model 3.

By quartile of prior (2022) proficiency

Table 19. Descriptives of ELA Growth Index by Quartile of Prior Proficiency, Model 3

	MODEL 3 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2022	44.7	45.6	6.2	26.8	54.5
Q2 ELA Proficiency 2022	48.5	47.5	4.2	40.8	58.3
Q3 ELA Proficiency 2022	49.3	49.2	5.0	37.9	60.6
Q4 ELA Proficiency 2022	55.1	54.8	3.8	45.0	63.8

Table 20. Descriptives of Math Growth Index by Quartile of Prior Proficiency, Model 3

	MODEL 3 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2022	44.5	45.8	6.5	27.6	52.3
Q2 Math Proficiency 2022	48.5	48.4	6.0	39.0	63.2
Q3 Math Proficiency 2022	50.2	50.0	5.7	38.6	62.8
Q4 Math Proficiency 2022	55.4	55.6	5.5	43.3	70.2

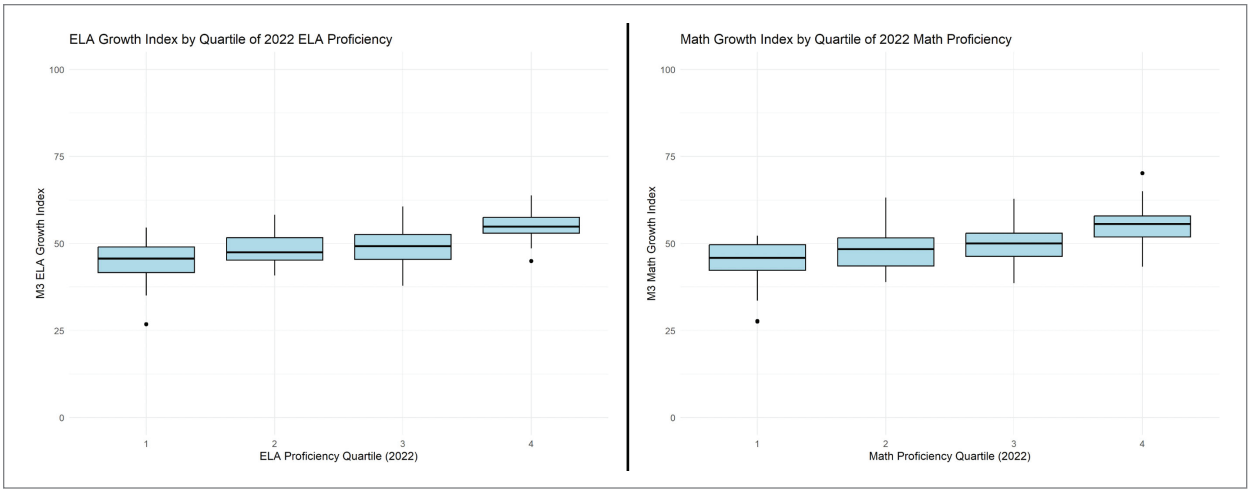

Figure 12. Boxplots of growth by quartile of prior proficiency, Model 3.

Model 4. The adequate growth percentiles (AGP) model

Table 21 and Figure 13 present the distributions of school-level growth indicators for Model 4, the adequate growth percentiles (AGP) model. The mean of 25.1 for ELA can be interpreted as the average, across schools, of the percentage of students making adequate progress, with "adequate progress" defined as discussed in the section describing the models.

Table 21. Descriptives of Growth Indicators, Model 4

						PERCENTILES				
Growth Index	Count	Mean	SD	Min	Max	10	25	50	75	90
ELA	153	25.1	9.3	0.0	49.5	12.8	18.1	25.8	30.4	37.8
Math	153	24.5	12.5	0.0	57.6	9.0	15.0	23.3	33.3	41.2

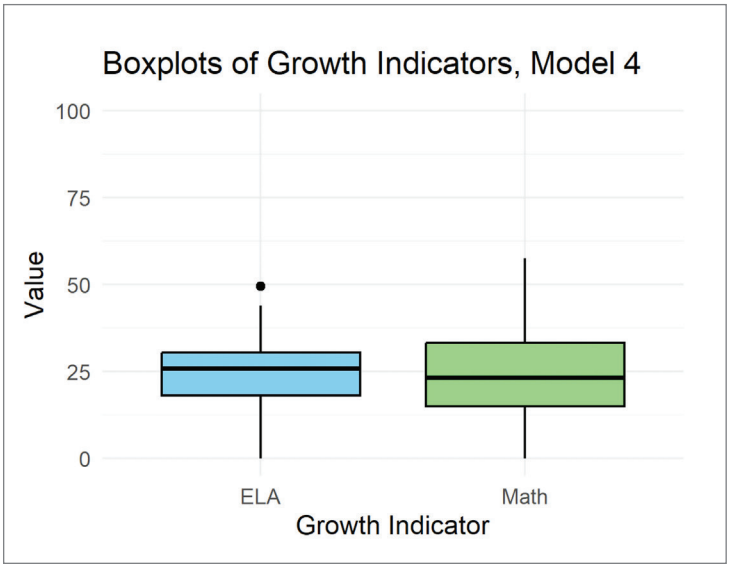

Figure 13. Boxplots of growth indicators, Model 4.

Table 22 and Figure 14 present the (Pearson) correlations between 2022-to-2023 growth and 2022 proficiency as .67 (ELA) and .80 (math). These are the largest among the models studied. There is a large correlation between growth across the two content areas (.87), which is also the largest among the models studied.

Table 22. Correlations among School-level Proficiency and Model 4 Growth Indices

	Proficiency ELA 2023	Proficiency Math 2023	Proficiency ELA 2022	Proficiency Math 2022	Growth ELA	Growth Math
Proficiency ELA 2023		0.92	0.97	0.93	0.72	0.73
Proficiency Math 2023	0.93		0.89	0.97	0.79	0.85
Proficiency ELA 2022	0.96	0.90		0.93	0.67	0.69
Proficiency Math 2022	0.94	0.97	0.93		0.76	0.80
Growth ELA	0.71	0.79	0.65	0.75		0.87
Growth Math	0.73	0.86	0.69	0.82	0.86	

Note: Correlations are Pearson (upper triangle) and Spearman (lower)

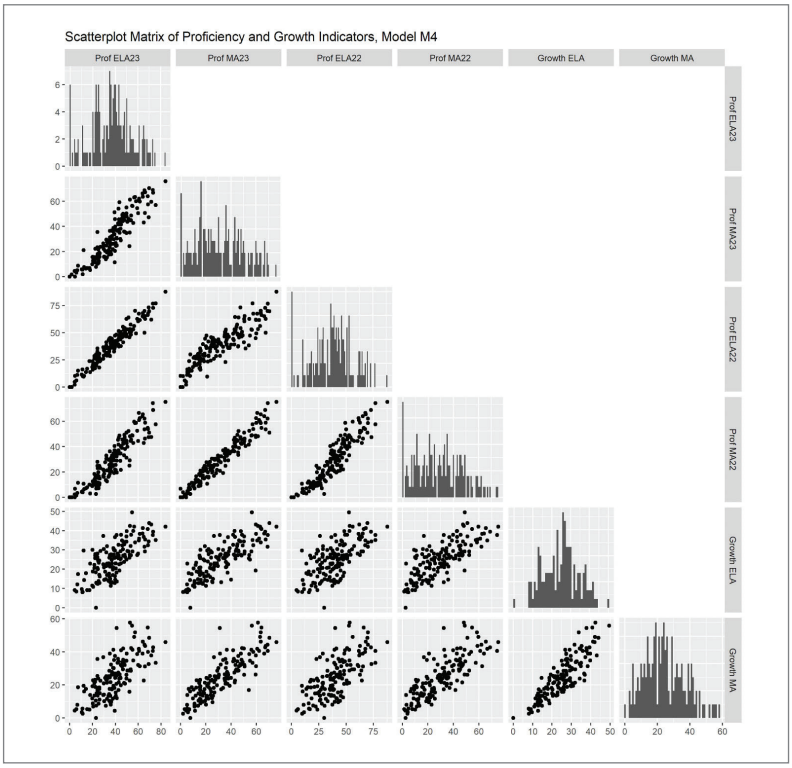

Figure 14. Scatterplot matrix of proficiency and growth indicators, Model 4.

Growth index by quartile of proficiency indicator

As with the other models, the trends of the growth indices across quartiles of current and prior proficiency reflect the correlations between the growth indices and proficiency indicators, as shown in the tables and figures below.

By quartile of current (2023) proficiency

Table 23. Descriptives of ELA Growth Index by Quartile of Current Proficiency, Model 4

	MODEL 4 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2023	17.3	17.9	7.9	0.0	30.0
Q2 ELA Proficiency 2023	20.6	20.6	6.1	11.4	37.3
Q3 ELA Proficiency 2023	26.5	27.0	6.3	12.9	37.9
Q4 ELA Proficiency 2023	34.9	35.1	6.1	25.0	49.5

Table 24. Descriptives of Math Growth Index by Quartile of Current Proficiency, Model 4

	MODEL 4 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2023	12.0	11.8	6.6	0.0	23.1
Q2 Math Proficiency 2023	17.6	16.7	6.2	8.0	36.8
Q3 Math Proficiency 2023	28.7	27.4	7.3	17.3	54.3
Q4 Math Proficiency 2023	39.0	39.0	8.8	16.8	57.6

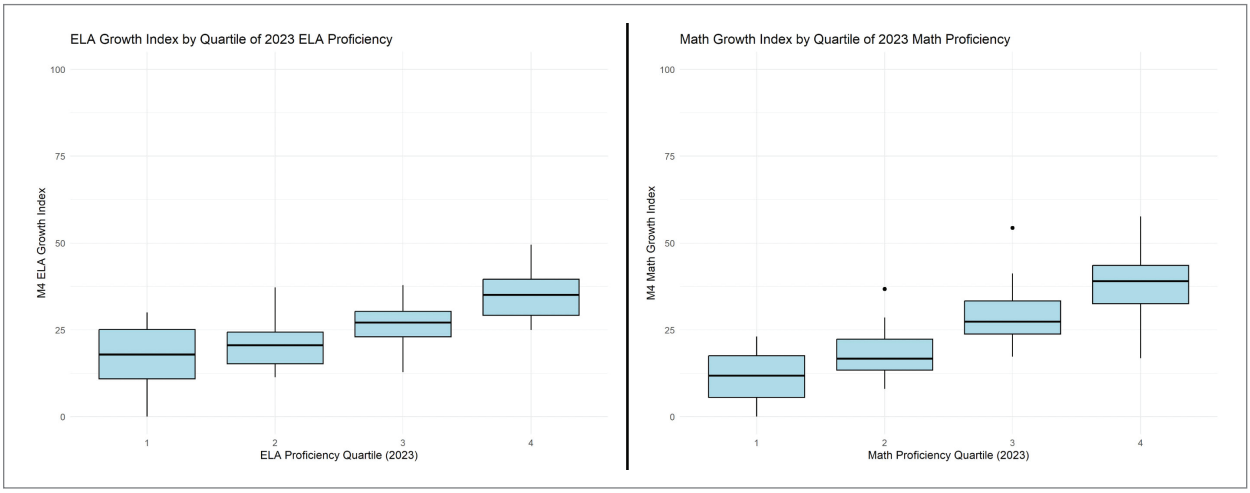

Figure 15. Boxplots of growth by quartile of current proficiency, Model 4.

By quartile of prior (2022) proficiency

Table 25. Descriptives of ELA Growth Index by Quartile of Prior Proficiency, Model 4

	MODEL 4 ELA GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 ELA Proficiency 2022	17.5	17.2	7.3	8.0	30.0
Q2 ELA Proficiency 2022	22.3	22.7	7.4	0.0	37.3
Q3 ELA Proficiency 2022	24.7	25.2	7.0	12.7	39.7
Q4 ELA Proficiency 2022	34.7	35.1	6.2	23.7	49.5

Table 26. Descriptives of Math Growth Index by Quartile of Prior Proficiency, Model 4

	MODEL 3 MATH GROWTH INDEX				
	Mean	Median	SD	Min	Max
Q1 Math Proficiency 2022	11.9	11.3	6.5	0.0	23.1
Q2 Math Proficiency 2022	19.0	17.2	7.9	8.0	38.9
Q3 Math Proficiency 2022	27.9	26.0	7.9	16.8	54.3
Q4 Math Proficiency 2022	38.3	38.2	8.7	21.6	57.6

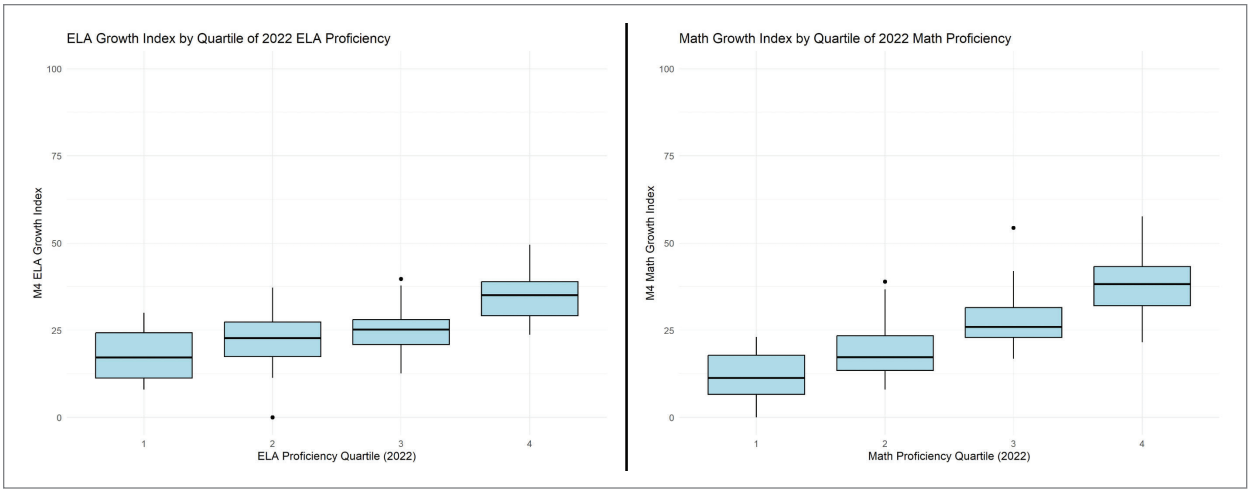

Figure 16. Boxplots of growth by quartile of prior proficiency, Model 4.

Evaluation Metrics for Models 1 through 4

Growth Model 1 is the current modified gain score model.

Growth Model 2 (2.2) is Model 1 with two differences: (1) The growth targets are updated to reflect 2022-to-2023 gain score distributions, and (2) The school-level growth index is entirely the average PGTA and does not include additional weight for the growth of those students in the lowest and highest quartile of prior achievement.

Growth Model 3 is a model where a school's growth index is the average SGP of its students.

Growth Model 4 compares each student's SGPs against the SGP they should have obtained to catch up or keep up (their AGP). A school's growth index is the percentage of students whose SGP equals or exceeds their AGP.

The evaluation metrics presented below demonstrate that the Delaware Growth Model is noticeably less related to prior (and current) achievement than either of the two SGP models. However, the correlations were generally higher for math than ELA for both models except for the standard SGP model.

The standardized comparisons of school-level growth index scores reveal that the current and modified Delaware models appear more equitable across schools at different prior and current achievement levels than the two SGP models. This follows from the correlations just discussed. Ideally, these values would be zero. A value of 1.0 on this index indicates that schools at the highest quartile of achievement (either prior or current) have an average growth index one standard deviation above the average growth index of schools in the lowest quartile of achievement. Based on standard interpretations of effect size (see Cohen, 1988 and Sawilowsky, 2009), this would indicate a large effect. Note the considerably higher index values for the SGP than the Delaware models.

Table 27. Evaluation Metrics for Models 1 through 4

	MODEL							
Metric	1	2	3	4	1	2	3	4
School-level correlation of growth and current achievement								
	Pearson				Spearman			
ELA	0.41	0.50	0.71	0.72	0.42	0.51	0.7	0.71
Math	0.52	0.62	0.64	0.85	0.54	0.64	0.65	0.86
School-level correlation of growth and prior achievement								
	Pearson				Spearman			
ELA	0.32	0.40	0.62	0.67	0.31	0.39	0.59	0.65
Math	0.42	0.52	0.55	0.8	0.45	0.55	0.56	0.82
Growth index mean for schools in the lower quartile of current achievement versus the upper quartile (shown: mean of Q4 minus mean of Q1 divided by SD pooled across quartiles)								
ELA	1.2	1.5	2.5	2.7				
Math	1.5	1.9	2.1	3.7				
Growth index mean for schools in the lower quartile of prior achievement versus the upper quartile (shown: mean of Q4 minus mean of Q1 divided by SD pooled across quartiles)								
ELA	0.9	1.2	2.1	2.5				
Math	1.3	1.7	1.8	3.4				

Study Group Feedback and Additional Analyses

The results of this study were shared with the Growth Study Group (meeting #4, September 12). The Growth Study Group members provided feedback, which we describe below. The Center for Assessment proposed additional next steps, also outlined below. The analyses are reported below.

Group members were surprised by the high correlations between prior percent proficiency and school mean SGP. They raised questions about what could be causing this. The study group and DDOE asked if this was due to either the test or the growth index (presumably to rule those out as contributing factors.) The Center for Assessment professionals said it is likely due to the grouping of students in schools, which is influenced by many social and economic factors. Members expressed interest in a deeper understanding of what drives this, suggesting at least disaggregating by elementary vs middle school. A group member asked, if these correlations express a state of affairs in the system rather than something inherent in the models, how much should we rely on the correlations to evaluate the models? This question highlights the limits of relying solely on our evaluation metrics in making decisions about growth models.

Members voiced concerns about having a 0/1 growth metric at the student level because this can lead to distorted incentives to focus only on students who are near their targets and to neglect those deemed too far away. This concern is relevant to Model 4. This concern was not with having an AGP but with reducing growth solely to a binary determination of whether a student attained their AGP. There are other ways to characterize the results of Model 4 if the group would like to pursue this model.

The group was skeptical of a uniform "by grade 8" target defining the Model 4 AGP horizons. One group member suggested that the "by grade 8" target for AGPs is unfair to upper elementary schools receiving transient students (and harsh to those students themselves). Another suggested that the way growth targets are set for ELPs, which consider their entry point into the system, could provide a good model for revising growth targets. Another member questioned why stop at eighth grade when four more years of schooling remain. However, continuous grade testing concludes by grade 8, so setting targets beyond 8th grade is impossible. Should the targets be driven by the lack of annual testing in high school? A suggestion was made to set the growth target as the next performance level rather than proficient for those below proficient.

On the grounds of utility, the group argued for preserving the upper and lower quartile components of the current growth index despite the high correlation between an index with and without these components (around .99, as shared with the group in an earlier meeting of the Growth Study Group). The reason is that structures are in place to help schools analyze their results by looking at the growth of students in the upper and lower quartiles of prior achievement, and schools have found this helpful in their planning.

A group member advocated for simplicity in explaining how to apply growth targets so that schools can readily do this with their data, not necessarily in terms of how the growth targets are derived.

Additional Analyses

1. Review/QA the school-level correlations for Model 3. This is to confirm that the correlations are indeed as large as computed in the first set of analyses.

2. Apply the SIMEX procedure (Shang, Van Iwaaarden, & Betebenner, 2015) to Model 3 and re-run the correlations between growth and prior achievement. The correlations between aggregate *observed* SGPs and aggregate *observed* prior achievement are influenced by measurement error in observed achievement measures. The SIMEX procedure corrects for this, estimating the correlations between aggregate *true* SGP and aggregate *true* prior achievement.

3. Investigate factors associated with the state's high school-level correlations between achievement and growth. Is there exceptionally high variability across schools on other dimensions, such as percent non-white, low-income, and ELL? Disaggregate the correlations by Elementary vs Middle School, if possible.

Review of correlations for models 3

We conducted an alternative procedure to compute the correlations between prior achievement (2022) and mean SGP (2023). In this alternative computation, prior achievement was not adjusted for participation rate. We filtered the data after SGPs were computed so that only schools with at least 15 valid SGPs would be included in the correlations. After this filtering, 153 schools were included in the correlation computations. The resulting (Pearson) correlations were 0.56 for ELA and 0.52 for math, which are close to the 0.62 and 0.55 computed by applying the DSSF business rules. These data, with prior achievement not adjusted for participation rate, are used in subsequent analyses.

Application of SIMEX procedure (model 3)

There are two types of SIMEX-corrected SGPs: SGP_SIMEX and SGP_SIMEX_RANKED. The difference is minimal in most cases; we recommend using SGP_SIMEX_RANKED.

We ran correlations at the school level for schools with >= 15 students between current growth (the school mean of SGP_SIMEX_RANKED) and prior achievement (the school's percent at/above proficient). The measurement error adjustment leads to somewhat lower correlations of about a tenth of a point from the uncorrected SGPs. This is consistent with what we've seen in other states, as presented in the table below.

Table 28. Correlation between Mean SGP and Prior Achievement, Uncorrected and SIMEX-corrected

	NON-SIMEX CORRECTED	SIMEX CORRECTED
ELA	0.62	0.46
Math	0.55	0.43

Note: Correlations are Pearson. Prior achievement is 2022 percent of students at or above proficient.

School-level factors associated with high growth-achievement correlations

Using the same data for the QA check above, we analyzed the correlations between prior achievement and growth by school characteristics. The school characteristics we examined were school classification (a proxy for grades served), school size, percent Caucasian (a proxy for race/ethnicity composition), and percent ELL. Note that due to the small number of schools, all correlations for subsets of schools should be interpreted cautiously.

School Type

Delaware provided official school classifications, which we matched with our data according to unique school identifiers. The table below displays counts of schools and the correlation coefficients of prior achievement and growth for ELA and math by school classification. Correlations for school classifications with fewer than ten schools are not reported.

Table 29. Correlation between Growth and Prior Achievement, by Official School Type

Official Classification		M1 (CURRENT MODEL)		M3 (SGP MODEL)	
School Type	**N**	**ELA**	**Math**	**ELA**	**Math**
All Schools	153	0.20	0.38	0.56	0.52
Elem/Middle/High	4	-	-	-	-
Elementary School	91	0.22	0.25	0.48	0.41
Elementary/Middle	14	0.32	0.12	0.67	0.55
High School	7	-	-	-	-
Middle School	34	0.49	0.53	0.69	0.67
Middle/High	3	-	-	-	-

Note: Correlations are Pearson. Prior achievement is 2022 percent of students at or above proficient, not adjusted for participation rate.

These results show that, regardless of the growth metric used, the correlations between prior achievement and growth are larger for middle schools than for elementary schools.

School Size

In the 2023 data, the 153 schools in our analyses ranged from 29 to 1457 students. To investigate the association between the achievement-growth correlation and school size, we divided schools into terciles (three groups of schools with approximately 51 schools in each group) based on the students in the 2023 data and computed within-group correlations.

Table 30. Correlation between Growth and Prior Achievement, by School Size, Models M1 and M3

			M1 (CURRENT MODEL)		M3 (SGP model)	
School size	**N Schools**	**Student N**	**ELA**	**Math**	**ELA**	**Math**
Small	52	29 to 257	0.35	0.35	0.55	0.42
Medium	51	261 to 451	0.07	0.31	0.55	0.56
Large	50	460 to 1457	0.32	0.61	0.62	0.65

Note: Correlations are Pearson. Prior achievement is 2022 percent of students at or above proficient, not adjusted for participation rate.

The current model correlations are in the .3s, with two exceptions: A low correlation in ELA for the middle third of school size and a high correlation in math for the largest schools. However, the SGP correlations show a more pronounced trend: Larger schools tend to have stronger correlations between prior percent proficient and mean SGP in both subjects, but more so in math.

School Demographics

Race/ethnicity composition

Delaware schools follow the federal categorization of combined race/ethnicity, with students classified into one of the following categories: Hispanic, regardless of race; Native American; African American; Caucasian; Asian; Native Hawaiian/Pacific Islander; and Multiracial.

There are several ways to analyze the association between school demographics and a school's race/ethnicity composition. As a first pass, we chose to look at the percent Caucasian, dividing the schools into thirds, as before.

Table 31. Correlation between Growth and Prior Achievement, by Tercile of Percent Caucasian, Models M1 and M3

			M1 (CURRENT MODEL)		M3 (SGP model)	
Percent Caucasian Tercile	**N Schools**	**Percent Caucasian**	**ELA**	**Math**	**ELA**	**Math**
First	51	0.0 to 26.2	0.16	0.36	0.46	0.33
Second	51	26.3 to 48.3	0.18	0.33	0.53	0.48
Third	51	48.5 to 82.2	0.15	0.51	0.49	0.43

Note: Correlations are Pearson. Prior achievement is 2022 percent of students at or above proficient, not adjusted for participation rate.

The correlations between prior achievement and growth under Delaware's current model do not vary greatly when disaggregated by school percent Caucasian, with the notable exception of math for the third tercile, where the correlation is much higher. That is, among schools with a high proportion of Caucasian students, the correlation between school-level prior achievement and school-level growth is higher than among other schools.

All correlations for the SGP model are in the 0.4-to-0.5 range, except for math for the first tercile. The schools with a smaller proportion of Caucasian students (and hence a greater proportion of other race/ethnicity categories) tend to exhibit a somewhat diminished correlation between prior achievement and SGP-based growth in math.

Proportion ELL

To explore the association between the proportion of ELL students and the correlation between school prior achievement and mean growth, we separated the 153 schools in our 2023 data into three groups by percent ELL, with the first ranging between 3.5 and less than 25.5 percent ELL, the second between 25.5 and less than 38.4 percent ELL, and the last between 38.4 and 79 percent ELL.

As shown in the table below, the correlation between prior ELA achievement and ELA growth under the current model is almost zero for schools with the lowest proportion of ELL students. It increases

for those schools with a higher percentage of ELL students. There is a slight decrease in the correlations with an increasing percentage of ELLs in math.

With SGPs—on the other hand—there is little difference in the correlation between prior ELA achievement and ELA growth across the three school groupings. However, as with growth under the current model, there is a difference in math, with a general decrease in the correlation with increasing percent ELL.

Table 32. Correlation between Growth and Prior Achievement, by Tercile of Percent English Language Learners

			M1 (CURRENT MODEL)		M3 (SGP model)	
Percent ELL Tercile	**N Schools**	**Percent ELL**	**ELA**	**Math**	**ELA**	**Math**
First	51	3.5 to <25.5	0.02	0.42	0.41	0.40
Second	51	>25.5 to <38.4	0.21	0.39	0.40	0.32
Third	51	>38.4 to 79	0.15	0.32	0.39	0.28

Note: Correlations are Pearson. Prior achievement is 2022 percent of students at or above proficient, not adjusted for participation rate.

SUMMARY AND FEEDBACK

The Delaware Department of Education (DDOE) convened a growth model study group to investigate whether the current Delaware growth model was working as intended and whether the model should be replaced with another growth model. The study group started by identifying the following characteristics they wanted to see in a Delaware growth model.

- Growth should have a weak relationship to prior school-level achievement
- Growth should not favor high- or low-achieving schools
- The growth model should be technically strong
- The model should be explainable to non-technical audiences

After considerable discussion of multiple growth models, the study group identified four models for subsequent investigation: the current Delaware Growth Model, the Delaware Growth Model with updated growth targets, the Student Growth Percentile Model, and the Adequate Growth Percentile Model. These four student longitudinal growth models were analyzed extensively to help the study group weigh the models against the identified priorities. Analyses included descriptive statistics and boxplots for the growth indices for each model, scatterplots of growth with achievement and the computation of four evaluation metrics:

1. The school-level correlation of growth with (contemporaneous) achievement
2. The school-level correlation of growth with prior achievement
3. The growth index mean for schools in the lower quartile of (contemporaneous) achievement versus the upper quartile.

4. The growth index mean for schools in the lower quartile of prior achievement versus the upper quartile.

Additional analyses for the Delaware Growth Model with updated growth targets were conducted to compute the updated growth targets, to compare them to current growth targets, and to evaluate the effect of capped versus uncapped versions of the growth index for that model.

Analyses revealed that the growth indices for the Delaware Growth Models (the original one and the one with updated growth targets) are noticeably less related to prior (and current) achievement than either of the two SGP models. Moreover, the standardized comparisons of school-level growth index scores showed that the current and modified Delaware models appear more equitable across schools at different prior and current achievement levels than the two SGP models.

In reviewing these results, the study group ruled out the Adequate Growth Percentile Model because of its high correlations with prior achievement and its favoring of higher-achieving schools. The Student Growth Percentile Model also had unusually high correlations with prior achievement, but the study group continued to consider it because of its strong technical quality.

The current Delaware Growth Model and the Delaware Model with updated targets had the lowest relationships with school-level prior achievement. This is partly due to the slightly negative individual-level correlations between prior achievement and student growth. Nevertheless, these models are used in the aggregate as part of the school accountability system, and the aggregate relationships matter most.

The study group endorsed the Delaware Growth Model with the updated targets because of the advantage of the lower aggregate correlations. Additionally, the "cost" of changing models in terms of training and communication could be substantial. Therefore, the study group advocated for continuing to use the Delaware Growth Model in the school accountability system.

Even though the current model had slightly lower correlations between prior achievement and growth than the model with updated growth targets, the study group strongly agreed that the updated targets were more appropriate since the original targets were set in 2018. Furthermore, the study group suggested that the targets should be revisited every five years or so.

Finally, the study group believed that part of the challenges associated with the current growth model has to do with the general lack of understanding of the model and how it works. Therefore, the study group requested that DDOE intensify its communication efforts to help the various constituents interpret and use the growth model results to support school improvement efforts, especially in light of any changes to growth targets.

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APPENDIX 1: PROFICIENCY INDICATORS

This appendix presents the distributions of–and interrelationships among–proficiency indicators. These are the same for all models.

Table 33 below provides descriptive of proficiency indicators for Delaware's schools. The means of the school-level percent of student proficient or above was 37.1% and 31.2% in ELA and math, respectively. That year, the schools with the lowest and highest percent of students proficient had 0 and 83.9% of students proficient in ELA. In math, that range was from 0 to 75.9%.

Table 33. Descriptives for Proficiency Indicators

	MEAN	MEDIAN	SD	MIN	MAX
Proficiency in ELA 2023	37.1	37.8	17.8	0.0	83.9
Proficiency in Math 2023	31.2	29.5	19.1	0.0	75.9
Proficiency in ELA 2022	37.8	38.9	18.4	0.0	87.8
Proficiency in Math 2022	29.0	28.8	18.2	0.0	75.2

These distributions are illustrated in Figure 17.

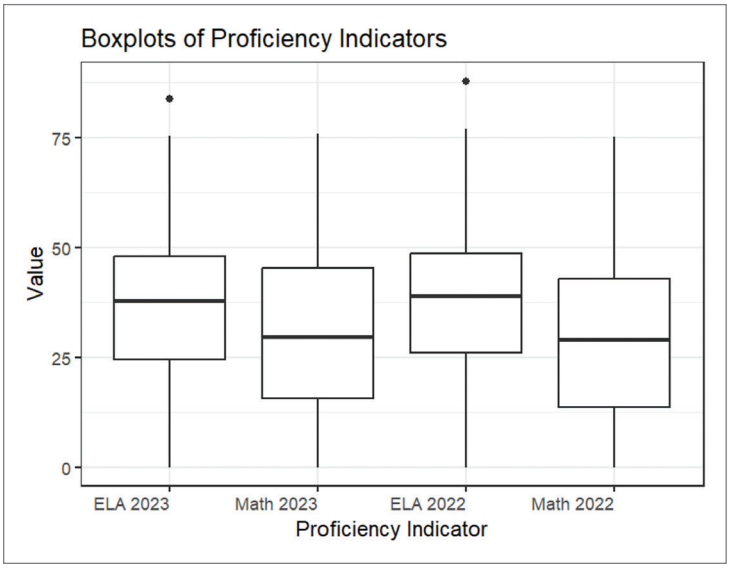

Figure 17. Boxplots of proficiency indicators.

School-level proficiency indicators are highly correlated across content areas and years, as shown in Table 34 and illustrated in Figure 18. The highest (Pearson) correlation coefficients are those for the same content areas between years (0.97 for each content area). The correlations within year between different content areas was 0.93. It is not unusual for these correlations to be large.

Table 34. Correlations among School-level Proficiency Indices

	ELA 2023	MATH 2023	ELA 2022	MATH 2022
ELA 2023		0.93	0.97	0.93
Math 2023	0.94		0.89	0.97
ELA 2022	0.96	0.90		0.93
Math 2022	0.94	0.97	0.93	

Note: Pearson (upper triangle) and Spearman (lower) indicating very strong relationships among the proficiency indicators.

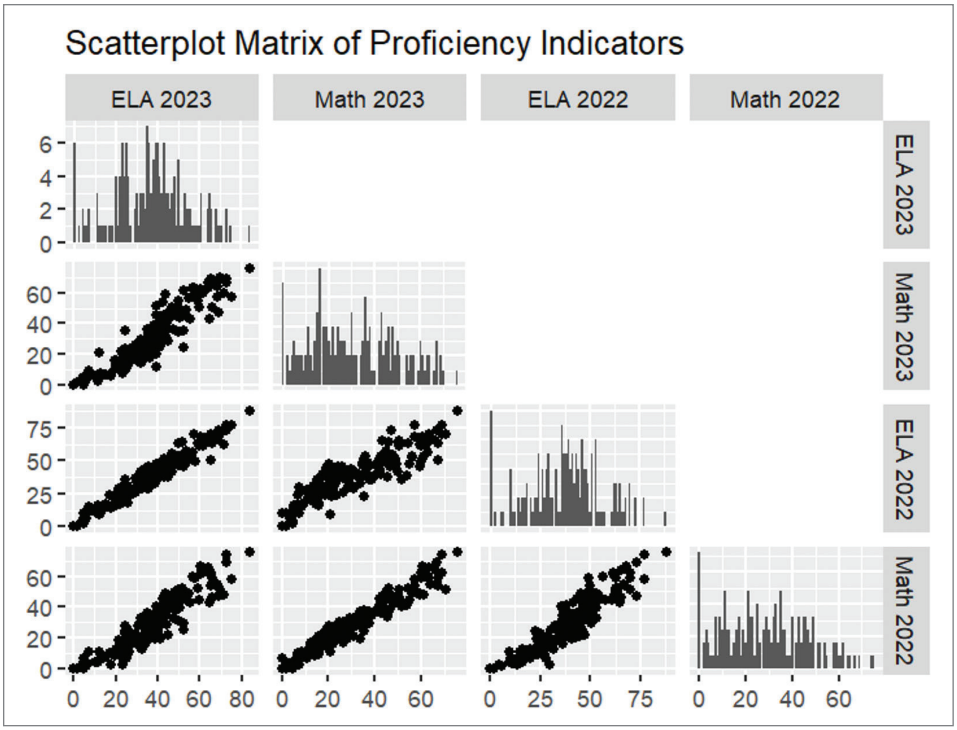

Figure 18. Scatterplot matrix of proficiency indicators.

APPENDIX 2: ADDITIONAL ANALYSES FOR MODEL 2

Variations on Model 2

The table below shows several variations on Model 2, which were explored during the analysis due to issues with the school-level growth indices computed for the originally planned Model 2, identified as Variation 2.0 in the table. The rationales for exploring each variation are described in the table.

Table 35. Variations on Model 2

MODEL VARIATION	PGTA CAPPING	GROWTH INDEX	RATIONALE
2.0	No	Mean-defined	The originally planned Model 2
2.1		Median-defined	Can computing the growth index using medians mitigate the effect (on school-level growth index distributions) of very high values produced by removing the cap on PGTA?
2.2	Yes	Mean-defined	Can keeping the cap on PGTA resolve any issues with the school-level growth index distributions under 2.0 and 2.1?
2.3		Median-defined	Are school-level growth index distributions more reasonable under a capped, median-defined model?

As discussed below, the final variation chosen for computing Model 2 evaluation metrics was Variation 2.2. In this variation, the growth targets were updated (true for all Model 2 variations), but the 110 cap on PGTA was not removed. The school-level growth index for Variation 2.2 was computed as originally planned for Model 2 - that is, as the mean PGTA of students in the school.

Updating growth targets

Updating growth targets for Model 2 began with reviewing the counts of students with 2022-to-2023 gain scores by proficiency bins in 2022. This was done separately for ELA and math. The counts for each bin should be at least 370[3]. Otherwise, it would be difficult to justify a computation of the 60th growth percentile.

Counts of school year 2023 growth-eligible students

Students are growth-eligible for a given year and content area if they have test scores in that content area for the given year and the year prior. The following tables show the growth-eligible students for school year 2023 by content area, displayed by bin and grade.

The bin sizes range from a low of 452 (math, grade 7, bin 4a) to a high of 3155 (math, grade 6, bin 1a). The by-grade-and-bin 60th percentiles of gain scores are estimated based on the student counts shown.

[3] Using the formula for the sample size for estimating a population proportion, the sample size required for a 95% confidence level and a 5% margin of error for the 60th percentile is approximately 370 cases.

Table 36. Number of Growth-Eligible Students, ELA, 2023

	BIN IN 2022							
Grade in 2022	1a	1b	2a	2b	3a	3b	4a	4b
3	2151	1158	1158	1110	1056	847	790	1034
4	2519	1021	910	1120	1056	920	889	982
5	1940	1146	990	1075	1361	1134	881	947
6	1965	1284	1304	1261	1392	1144	620	533
7	1834	987	1232	1246	1623	1373	712	605

Table 37. Number of Growth-Eligible Students, Math, 2023

	BIN IN 2022							
Grade in 2022	1a	1b	2a	2b	3a	3b	4a	4b
3	2336	942	1059	1136	1326	1023	617	904
4	2160	1065	1461	1388	1137	927	566	754
5	2872	1231	1483	1120	788	654	542	805
6	3155	1182	1446	1291	736	626	469	625
7	2828	1363	1551	1186	992	618	452	616

Updated growth targets

For a given content area, a 2022-to-2023 raw gain score is a student's scale score in 2023 minus their scale score in 2022. The by-grade-and-bin 60th percentiles of these 2022-to-2023 raw gain scores were computed and are displayed in the following tables. These represent the updated growth targets for ELA and Math.

Table 38. Updated Growth Targets (2022-to-2023), ELA

	BIN							
Grade	1a	1b	2a	2b	3a	3b	4a	4b
3	85	59	57	54	51	51	49	27
4	80	59	47	55	49	54	47	29
5	55	27	23	17	13	7	3	1
6	67	51	48	48	42	34	29	7
7	60	32	26	26	17	13	11	1

Notes: (a) The 60th percentile for Grade 3, bin 2b is 54.4. It has been rounded to 54. (b) The 60th percentile for Grade 5, bin 4b is -14. It has been replaced with 1. (c) The 60th percentile for Grade 7, bin 4b is -8. It has been replaced with 1.

Table 39. Updated Growth Targets (2022-to-2023), Math

	BIN							
Grade	1a	1b	2a	2b	3a	3b	4a	4b
3	77	56	56	56	54	50	47	41
4	62	45	45	43	46	43	37	30
5	38	22	23	22	21	25	26	16
6	60	32	26	31	33	33	37	22
7	55	19	13	11	17	17	21	14

Notes: (a) The 60th percentile for Grade 3, bin 1b is 55.6. It has been rounded to 56. (b) The 60th percentile for Grade 5, bin 1a is 37.6. It has been rounded to 38. (c) The 60th percentile for Grade 5, bin 3a is 21.2. It has been rounded to 21. (d) The 60th percentile for Grade 6, bin 4a is 36.8. It has been rounded to 37.

Comparison to current (Model 1) growth targets

The growth targets estimated using 2022-to-2023 growth skew lower than those currently used in Delaware, i.e., those estimated using 2016-to-2017 growth. In ELA, the newer growth targets range from 16 points lower than the current ones (in Grade 5, bins 2b and 3b) to 12 points higher (Grade 3, 1a). In Math, the newer growth targets range from 31 points lower than the current ones (Grade 7, 4b) to 13 points higher (Grade 4, 1a).

Table 40. Growth Targets for 2022-to-2023 Minus Growth Targets for 2016-to-2017, ELA

	BIN							
Grade	1a	1b	2a	2b	3a	3b	4a	4b
3	12	-2	-2	-5	0	3	3	-10
4	5	0	-13	-3	-2	7	8	-3
5	1	-10	-8	-16	-10	-16	-12	-9
6	4	-2	2	3	8	3	2	-13
7	-1	-12	-7	-8	-6	-6	-2	-1

Table 41. Growth Targets for 2022-to-2023 Minus Growth Targets for 2016-to-2017, Math

	BIN							
Grade	1a	1b	2a	2b	3a	3b	4a	4b
3	8	0	2	4	4	2	-1	3
4	13	3	9	4	8	1	-7	-3
5	-2	-18	-15	-15	-8	-4	-2	-16
6	8	-4	-10	-3	1	0	3	-10
7	0	-6	-8	-11	-13	-14	-20	-31

These differences should be interpreted with caution for at least two reasons. First, Smarter Balanced has changed its scale since the 2016 and 2017 administrations. Second, these later gain scores are based on post-pandemic cohorts six years later than the original groups. These factors can distort interpretations of differences in the growth targets.

Nonetheless, we recommend validating new growth targets using other growth data, such as 2023-to-2024 data, and possibly pooling across recent years.

Uncapped vs. capped PGTAs

The originally planned Model 2 uses uncapped PGTAs. Because removing the cap produces a very large range of PGTAs (spanning five orders of magnitude - from 0 to tens of thousands), we explored variations of Model 2 that maintain the cap of 110. See Appendix 3 for summary statistics on the individual-level PGTA distributions for 2023 for both the uncapped (2.0 and 2.1) and capped (2.2 and 2.3) variations of Model 2.

School-level growth index

The originally planned Model 2 uses a mean-defined school growth index. The table below shows that the mean-defined growth indices for uncapped PGTAs (Variation 2.0) exhibit very little variability, with most schools obtaining the maximum score. The median-defined growth indices (Variation 2.1) have more reasonable distributions.

Table 42. Descriptives of Growth Indices for Uncapped Percent Growth of Target Achieved (PGTA)

VARIATION 2.0 AND 2.1 GROWTH INDEX (UNCAPPED)					PERCENTILES				
Growth Index	Mean	SD	Min	Max	10	25	50	75	90
ELA (2.0: mean-defined)	100	0	100	100	100	100	100	100	100
ELA (2.1: median-defined)	71.9	30.8	0	100	24	51.6	80.6	100	100
Math (2.0: mean-defined)	99.9	0.6	94.6	100	100	100	100	100	100
Math (2.1: median-defined)	75	31.2	0	100	25.5	49.2	92.1	100	100

Maintaining the cap on PGTAs and defining the school growth index using the school's mean PGTAs (Variation 2.2) removes the ceiling effect present in other variations. (Variation 2.2 is shaded in grey in the table below.)

Table 43. Descriptives of Growth Indices for Capped Percent Growth of Target Achieved (PGTA)

VARIATION 2.0 AND 2.1 GROWTH INDEX (UNCAPPED)					PERCENTILES				
Growth Index	Mean	SD	Min	Max	10	25	50	75	90
ELA (2.2: mean-defined)	57.7	9.0	28.4	78.4	47.4	52.4	57.8	63.2	69.8
ELA (2.3: median-defined)	71.9	30.8	0	100	24	51.6	80.6	100	100
Math (2.2: mean-defined)	60.0	10.8	34.8	91.5	46.1	52.7	59.4	66.9	75.1
Math (2.3: median-defined)	75	31.2	0	100	25.5	49.2	92.1	100	100

APPENDIX 3: STUDENT-LEVEL GROWTH METRIC DISTRIBUTIONS

Model 1

ELA (2023)

Table 44. Student-level Growth Metric Descriptives for Model 1, ELA 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9291	61.3	47.5	0.0	110.0	0.0	0.0	11.0	43.5	72.6	102.0	110.0	110.0	110.0
5	9401	61.1	47.5	0.0	110.0	0.0	0.0	10.7	42.4	71.2	102.6	110.0	110.0	110.0
6	9479	46.1	50.3	0.0	110.0	0.0	0.0	0.0	0.0	13.0	66.7	110.0	110.0	110.0
7	9507	59.2	49.2	0.0	110.0	0.0	0.0	0.0	33.3	70.6	105.7	110.0	110.0	110.0
8	9596	49.2	50.7	0.0	110.0	0.0	0.0	0.0	0.0	27.3	79.5	110.0	110.0	110.0

Math (2023)

Table 45. Student-level Growth Metric Descriptives for Model 1, Math 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9326	67.7	44.5	0.0	110.0	0.0	5.3	35.4	60.9	83.9	107.1	110.0	110.0	110.0
5	9445	63.5	47.8	0.0	110.0	0.0	0.0	13.2	50.0	81.0	110.0	110.0	110.0	110.0
6	9500	48.5	49.7	0.0	110.0	0.0	0.0	0.0	0.0	28.9	72.4	110.0	110.0	110.0
7	9533	56.2	49.5	0.0	110.0	0.0	0.0	0.0	19.4	59.6	97.2	110.0	110.0	110.0
8	9589	48.3	50.3	0.0	110.0	0.0	0.0	0.0	0.0	25.5	74.5	110.0	110.0	110.0

Model 2 uncapped (applicable to Variations 2.0 and 2.1)

ELA (2023)

Table 46. Student-level Growth Metric Descriptives for Model 2, Uncapped, ELA 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9291	93.4	101.5	0	1418.5	0	0	10.6	42.6	71.2	100	129.6	166.7	221.6
5	9401	93.5	97.8	0	758.6	0	0	10.9	42.5	70.2	100	131.9	170	228.6
6	9479	312	1018.1	0	19200	0	0	0	0	17.6	90.9	172.7	295.9	617.4
7	9507	104.5	156.7	0	3342.9	0	0	0	31.3	66.7	100	137.5	180.6	244.1
8	9596	209.4	748.7	0	16000	0	0	0	0	33.3	96.7	165.4	253.8	423.1

Math (2023)

Table 47. Student-level Growth Metric Descriptives for Model 2, Uncapped, Math 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9326	88.7	77.7	0	785.4	0	4.9	33.8	57.1	78	100	123.3	151.8	191.5
5	9445	90.3	93.4	0	1473.3	0	0	11.3	44.2	71.7	100	130	164.6	214
6	9500	116	162.9	0	3575	0	0	0	0	40.9	100	160.5	231.3	333.4
7	9533	102.3	127.1	0	1931.8	0	0	0	20	60	100	141.7	193.3	271.8
8	9589	145.2	223.2	0	3357.1	0	0	0	0	34.5	100	171.4	265.5	447.1

Model 2, capped (applicable to Variations 2.2 and 2.3)

ELA (2023)

Table 48. Student-level Growth Metric Descriptives for Model 2, Capped, ELA 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9291	61	47.4	0	110	0	0	10.6	42.6	71.2	100	110	110	110
5	9401	60.9	47.3	0	110	0	0	10.9	42.5	70.2	100	110	110	110
6	9479	49.3	51.9	0	110	0	0	0	0	17.6	90.9	110	110	110
7	9507	58.3	48.9	0	110	0	0	0	31.3	66.7	100	110	110	110
8	9596	51.2	51.6	0	110	0	0	0	0	33.3	96.7	110	110	110

Math (2023)

Table 49. Student-level Growth Metric Descriptives for Model 2, Capped, Math 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9326	66.1	44.2	0	110	0	4.9	33.8	57.1	78	100	110	110	110
5	9445	61.2	47.2	0	110	0	0	11.3	44.2	71.7	100	110	110	110
6	9500	52.4	51.3	0	110	0	0	0	0	40.9	100	110	110	110
7	9533	56.6	49.6	0	110	0	0	0	20	60	100	110	110	110
8	9589	51.6	51.7	0	110	0	0	0	0	34.5	100	110	110	110

Model 3

ELA (2023)

Table 50. Student-level Growth Metric Descriptives for Model 3, ELA 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9330	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
5	9457	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
6	9516	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
7	9523	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
8	9617	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90

Math (2023)

Table 51. Student-level Growth Metric Descriptives for Model 3, Math 2023

						DECILES								
Grade	**N**	**Mean**	**SD**	**Min**	**Max**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
4	9364	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
5	9494	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
6	9529	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
7	9546	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90
8	9607	50.0	28.9	1	99	10	20	30	40	50	60	70	80	90

Model 4

ELA (2023) and Math (2023)

Table 52. Student-level Growth Metric Descriptives for Model 4, 2023

	ELA				MATH		
Grade	N	Mean	SD		N	Mean	SD
4	8426	0.30	0.46		8660	0.29	0.46
5	8348	0.27	0.44		8915	0.29	0.45
6	9018	0.27	0.44		8995	0.25	0.43
7	8443	0.21	0.41		8737	0.18	0.38
8	8829	0.13	0.33		9111	0.12	0.32

APPENDIX 4: STUDENT-LEVEL CORRELATIONS OF GROWTH METRICS WITH ACHIEVEMENT

The table below displays the Pearson correlation coefficients of the student-level growth metric for each model, with current (2023) and prior (2022) achievement.

Legend:

Cross-content area correlations are in this font
Correlation of SGP with Prior Achievement
Correlation of SGP with Current Achievement

Table 53. Student-level Pearson Correlations between Growth Metric and Achievement, Models 1 through 4

		ELA GROWTH				MATH GROWTH			
Scale Score	Growth Metric	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
ELA, 2023		0.38	0.39	0.57	0.45	*0.12*	*0.15*	*0.26*	*0.32*
Math, 2023		*0.16*	*0.17*	*0.30*	*0.31*	0.35	0.39	0.53	0.52
ELA, 2022		-0.16	-0.14	0.00	0.13	*0.00*	*0.04*	*0.15*	*0.23*
Math, 2022		*0.06*	*0.07*	*0.20*	*0.24*	-0.15	-0.11	0.00	0.25

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