Proposed Methodology for Defining Learning Gains

At a Glance

This report examines one component of the current school accountability system - learning gains. We find that learning gain percentages are affected by a variety of factors including starting achievement level, socioeconomic status, and English language learner status when the current definition of learning gains is used. Hence, we propose a new methodology for defining learning gains in terms of scale score increase targets. Under this new definition, students who are behind their peers in academic achievement will be required to demonstrate higher scale increases to meet the target for learning gains. We find that the proposed definition of learning gains reduces the variability in percentages of students making such gains depending on their initial achievement results. In addition, it reduces the gap between the learning gain percentages for certain accountability subgroups.

In January 2020, Governor DeSantis announced the creation of new State academic standards, which will be called the BEST (Benchmarks for Excellent Student Thinking) Standards. The published timeline anticipates the implementation of the BEST English Language Arts (ELA) standards in 2021-2022, and those in mathematics – in 2022-2023. The implementation of the new standards will require the creation of new assessments aligned to these standards. The implementation timeline also states that the school year 2021-2022 will be the last one in which the Grade 9 ELA assessment and Geometry EOC assessment are administered. The elimination of these assessments will necessitate changes to the State's school accountability system.

The current school accountability system has many components, one of which is the percentage of students making learning gains. In this Research Brief, we propose a new method for defining what constitutes a learning gain.

The Current Definition of Learning Gains and its Implications

The results of the Florida State Standards (FSA) testing in ELA and mathematics are reported in terms of scale scores and Achievement Levels ranging from 1 to 5. A student scoring within Achievement Levels 3-5 is considered achieving "at grade level". The Achievement Levels are defined in terms of specific ranges of scale scores. For example, in Grade 3, the interval of scale scores ranging from 240 to 284 in both ELA

and mathematics define Achievement Level 1. Because the FSA scale is constructed to be vertical[1], the endpoints of the range defining a particular Achievement Level increase from one grade level to the next. For instance, the interval ranging from 251 to 296 define the Achievement Level 1 for Grade 4 ELA results, while the interval from 251 to 298 define that for mathematics.

To define learning gains, the scale score ranges defining Achievement Level 1 in each grade and subject are subdivided into the three smaller sublevels of approximately equal width (Level 1 Low, Middle, and High), while the ranges for Achievement Level 2 are divided into two sublevels (Level 2 Low and High) as shown in Table 1 below for ELA scores.

Table 1

FSA ELA Scale Score Ranges for Learning Gains

Grade	L1 Low		L1 Middle		L1 High		L2 Low		L2 High		Level 3		Level 4		Level 5	
Grade 3	240	254	255	269	270	284	285	292	293	299	300	314	315	329	330	360
Grade 4	251	266	267	281	282	296	297	303	304	310	311	324	325	339	340	372
Grade 5	257	272	273	288	289	303	304	312	313	320	321	335	336	351	352	385
Grade 6	259	275	276	292	293	308	309	317	318	325	326	338	339	355	356	391
Grade 7	267	283	284	300	301	317	318	325	326	332	333	345	346	359	360	397
Grade 8	274	289	290	305	306	321	322	329	330	336	337	351	352	365	366	403
Grade 9	276	293	294	310	311	327	328	335	336	342	343	354	355	369	370	407
Grade 10	284	300	301	317	318	333	334	341	342	349	350	361	362	377	378	412

According to the current definition of learning gains for a student who has assessment results in the same subject in two consecutive school years, the student can demonstrate a learning gain in several ways:

- Advance by at least one Achievement Level,
- For students who score within Achievement Level 1 in both years or Level 2 in both years, advance at least one sublevel,
- For students who score within Achievement Level 3 in both years or Level 4 in both years, increase a scale score by at least one point, or
- Remain within Achievement Level 5 in both years.

Notice that a student can demonstrate a learning gain when advancing by as little as 4 scale score points (from 272 in Grade 5 to 276 in Grade 6) or even when losing as much as 33 scale score points (from 403 in Grade 8 to 370 in Grade 9). Figure 1 shows the percentages of students across grades 3-9 making learning gains in ELA[2] from 2018 to 2019 across all Grade 3-9 by students' initial Achievement Level or Sublevel.

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[1] In an ideal vertical scale, equal increases in scale scores signify equal amounts of learning across time.

[2] In the rest of the document, we limit examples to ELA results of students who advanced to a next grade level from 2017-2018 to 2018-2019 school year.
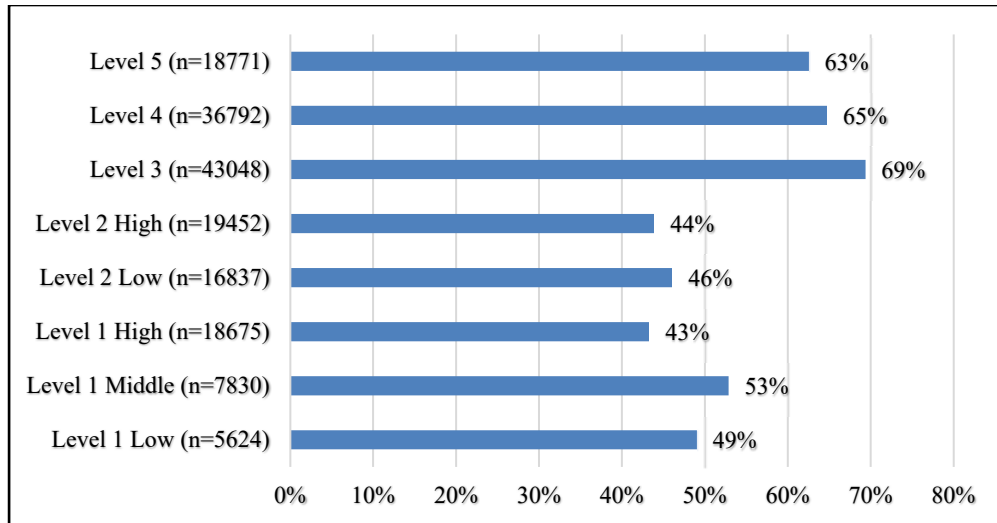
Figure 1. Percentages of Students Making Learning Gains from 2018 to 2019

Clearly, the percentage of students making learning gains had a large variability ranging from 43% of students who were in Achievement Sublevel 1 High to 69% of students who were in the Achievement Level 3 in 2018.

To illustrate the idiosyncratic consequences of the learning gains definition further, we used the data from students who went from Grade 3 in 2018 to Grade 4 in 2019, as an example. We split the range of scale scores in ELA into 20 subintervals so that each interval corresponded to roughly 5% of students who scored within this interval on the 2018 FSA ELA. Each interval contained about 1,000 students. We then determined the percentages of students making learning gains for each of these 20 subintervals; the results are shown in Figure 2.
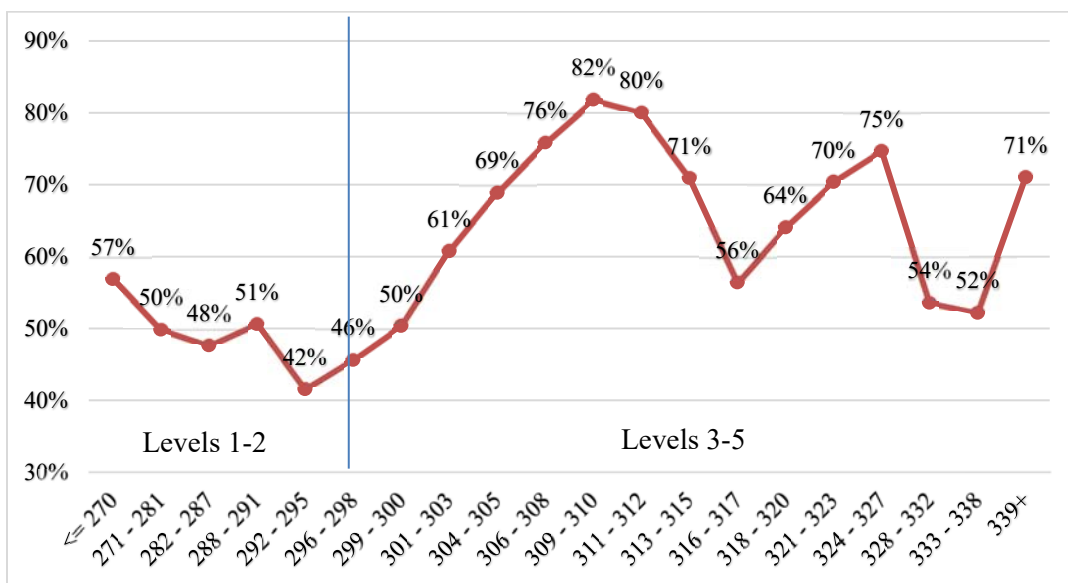

Figure 2. Percentages of Grade 3 Students Making Learning Gains from 2018 to 2019 by 2018 Scale Score Interval

The variability of the learning gains percentage shown in Figure 2 is rather large ranging from 42% to 82% demonstrating the differential impact of the definition of learning gains depending on the initial scale score. The percentages of students making learning gains were much lower for students who scored within Achievement Levels 1-2 on the 2018 FSA ELA assessment (shown to the left of the vertical line in Figure 2) than for those who scored within Achievement Levels 3-5.

Because following the current definition of making a learning gain it is easier to demonstrate learning gains for students who score proficient (within Achievement Levels 3-5), there is a differential impact on student subgroups in terms of proportions of students making learning gains. We illustrate this impact by examining two accountability subgroups: economically disadvantaged students (defined as students eligible for the federal free or reduced-price lunch [FRL]) and English Language Learners (ELL), defined here as those who were in the ESOL program as of May 1, 2019, or exited the program within the 2-year interval from that date. The results are shown in Figure 3, which displays the percentages of students making learning gains (the left axis) and the mean gains in scale scores from Grade 3 in 2018 to Grade 4 in 2019 (right axis).
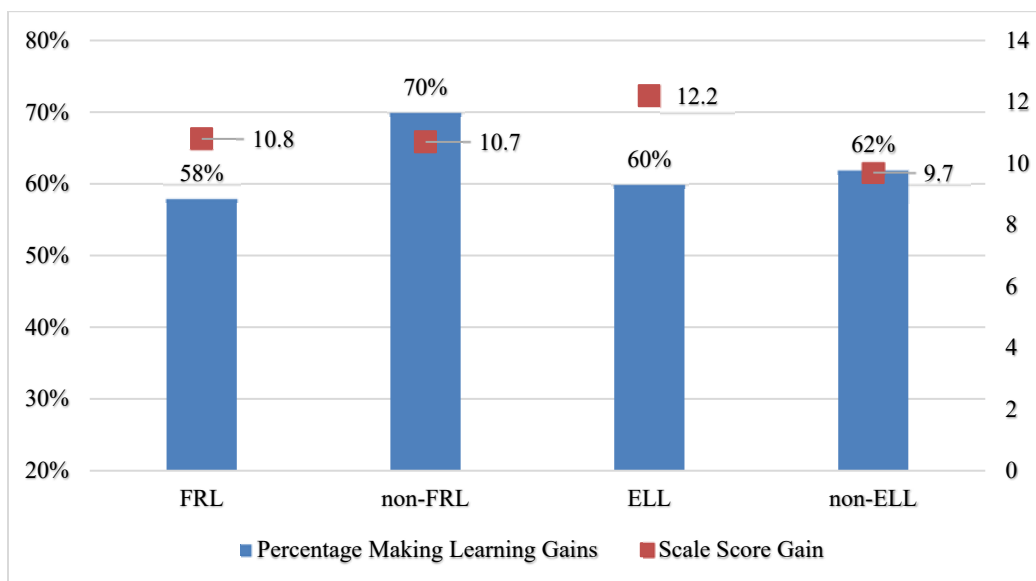

Figure 3. Percentages of Students Making Learning Gains and the Mean Scale Score Gains from Grade 3 in 2018 to Grade 4 in 2019 by Student Subgroup

Economically disadvantaged students demonstrated a smaller percentage of making learning gains compared with the non-economically disadvantaged counterparts despite making approximately equal gains in scale scores from 2018 to 2019. The comparison of the two outcome statistics shows that ELL students made considerably larger gains in scale score points than their non-ELL peers; yet, their percentage of making learning gains was smaller.

Schools in which ELL and economically disadvantaged subgroups are represented to a large degree are likely to demonstrate smaller learning gains due, at least in part, to the disparate effect of the definition of learning gains on subgroups. Figure 4 shows a relationship between the percentage of FRL students and the percentage of students making learning gains from 2018 to 2019 for 100 randomly selected District schools.
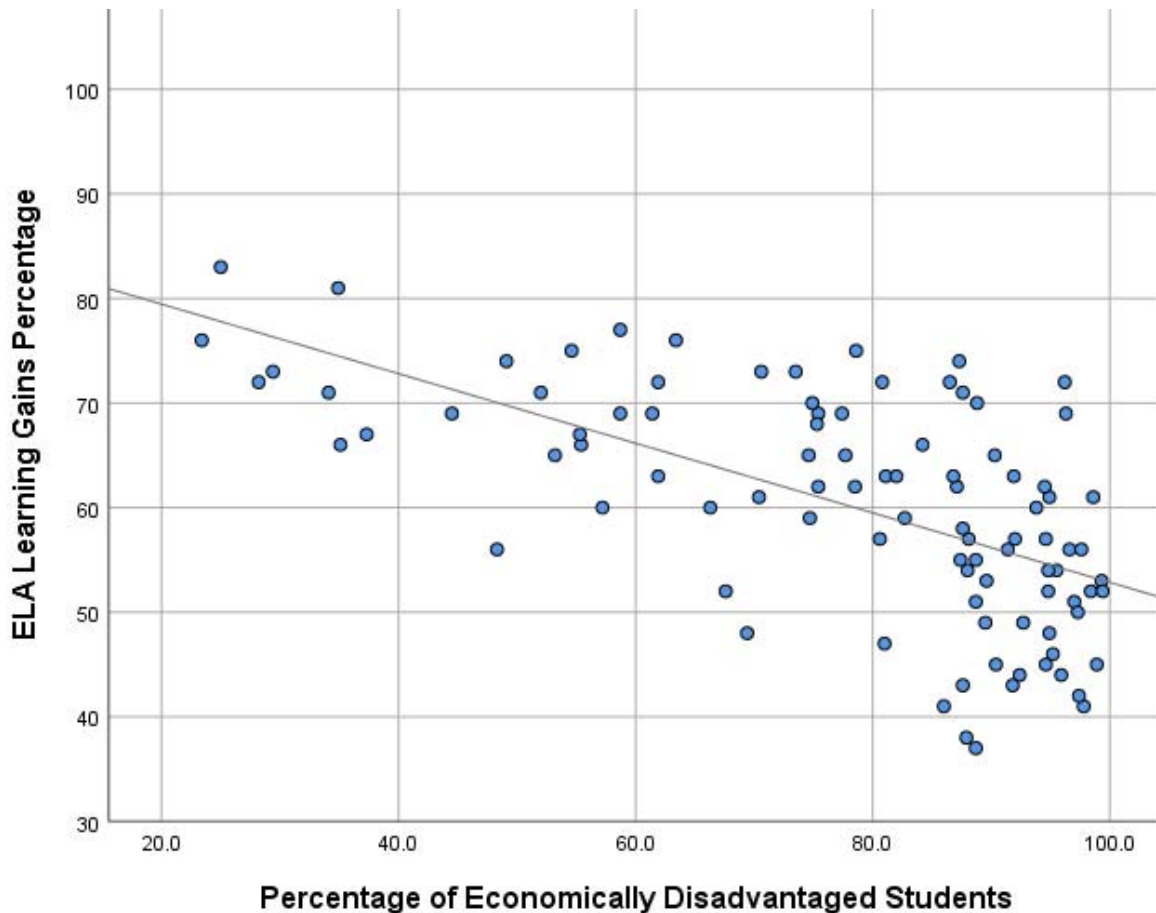
Figure 4. Percentages of Students Making Learning Gains from 2018 to 2019 by School Percentage of FRL Students

The inverse relationship between the school percentages of FRL students and learning gains can be seen clearly in Figure 4. When the data on all District schools are used, the value of the coefficient of determination R^2 is approximately .30 indicating that about 30% of the differences in school percentages of students making learning gains can be explained by their percentages of economically disadvantaged students. The values of R^2 by school type were .29, .63, .38, and .30 for Elementary, Middle, High, and Combination schools respectively.

Toward an Alternative Definition of Learning Gains

If the pattern of academic growth in ELA were similar for all grade levels, it would be possible to establish a common definition of learning gains across grades. This is not the case, as shown in Figure 5, which demonstrates that the mean changes in scale scores from 2018 to 2019 varied by the grade in a somewhat haphazard manner.
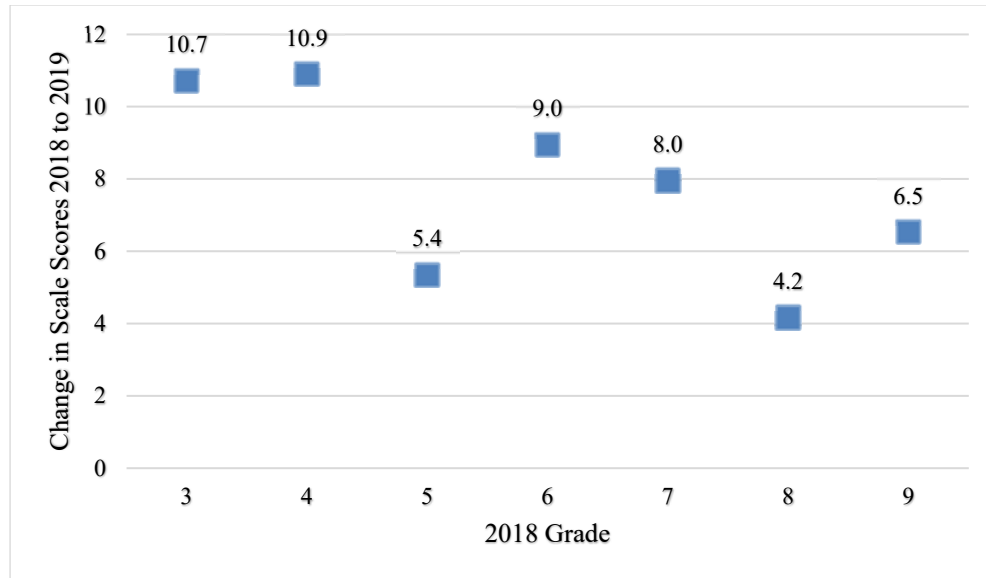
Figure 5. Mean Differences Between 2019 and 2018 FSA Scale Scores by Student Grade

Thus, a definition of learning gains in terms of scale score gain would need to be established separately for different grades. We demonstrate a proposed methodology for establishing a definition of learning gains using an example of Grade 3 to Grade 4 growth in scores. We think that a reasonable definition of learning gains should require students who are not yet performing at grade level to demonstrate larger amounts of growth than students who are already performing at grade level. Students who are farther behind should demonstrate larger academic growth for it to be considered a "learning gain". On the other hand, even those students who are performing on grade level should demonstrate some amount of growth with a possible exception of students whose scale scores are close to the maximum of the scale.

To investigate the pattern of ELA academic growth for students promoted from Grade 3 in 2018 to Grade 4 in 2019, we split the student population into deciles and calculated the mean amount of growth in scale score points and its standard deviation by decile (see Table 2). One can see a decreasing relationship between student scale score gains and the decile of their initial scale score[3]. In addition, it shows heteroscedasticity (unequal measures of spread, such as standard deviation) of the gain scores depending on the initial score decile.

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[3] This inverse relationship is due, at least in part, to the statistical/measurement phenomenon known as the regression toward the mean.

Table 2

Mean Growth in FSA ELA Scale Scores from Grade 3 in 2018 to Grade 4 in 2019 and their Standard Deviations by Student 2018 Decile

Decile	N	Mean Growth	Std. Deviation
1	2344	21	17.6
2	2545	14	13.2
3	2204	12	12.3
4	2270	11	11.7
5	2447	11	11.9
6	2483	10	11.2
7	2442	10	10.9
8	2452	9	11.1
9	2226	7	11.1
10	2394	2	11.6

We used quantile regression to calculate the expected amounts of scale score gain depending on the initial (2018) scale scores of students in Grade 3. Unlike standard least-squares linear regression, quantile regression can be used in the presence of heteroscedasticity of outcome scores. In addition, the quantile regression can be fitted not just for the mean outcome, but for various percentile values of the outcome. We fitted the quantile regression for percentiles ranging from 40th to 60th with 5-point increments.

Although it is possible to use the results of the quantile regression analysis to establish the learning gain targets for each of the initial scale scores, we think this would be impractical. Student groupings, such as deciles, can be used for this purpose. This approach, too, might be impractical because the boundaries for deciles are likely to shift from one test administration to the next. Instead, we used the already established definition of Achievement Levels and Sublevels and then defined targets for increases in scale score points equal to the means of expected score growth from the quantile regression analysis (based on the 40th percentile). These targets, the resulting percentages of students making learning gains, and those based on the current rule for calculating learning gains are shown in Table 3 below.

It can be seen that the largest difference between the percentages of students making learning gains based on the proposed targets by their initial Achievement Level is 9 percentage points. By way of comparison, the largest such difference based on the current definition of learning gains is 31 percentage points.

Table 3

Targets for Growth in FSA ELA Scale Scores from Grade 3 in 2018 to Grade 4 in 2019 by Student 2018 Achievement Level, the Resulting and Current Percentages of Students Making Learning Gains

2018 Achievement Level	N	Target	Proposed	Current
Level 1 Low	305	22	63%	63%
Level 1 Middle	857	18	59%	57%
Level 1 High	1811	15	62%	52%
Level 2 Low	2257	12	60%	49%
Level 2 High	2764	11	57%	42%
Level 3	7293	8	63%	73%
Level 4	5633	5	66%	66%
Level 5	2887	1	59%	57%
Overall	23807		62%	61%

Figure 6 contrasts percentages of students making learning gains from Grade 3 in 2018 to Grade 4 in 2019 depending on their 2018 scale score under the current and proposed definitions of making a learning gain. It can be observed that the proposed definition leads to a more uniform pattern. The exception to that pattern occurs for students who scored at the upper range of Achievement Level 5 in 2018. A closer examination of these students' results shows that Grade 3 students who scored 349 or above on the 2018 FSA ELA (approximately 400 such students, or about one-third of the highest scoring group in Figure 6) had an average of 6.4 scale score points loss from 2018 to 2019 testing. In that group, 78% made learning gains by the current definition despite "losing ground" on the scale score metric, but only 27% made it by the proposed definition.
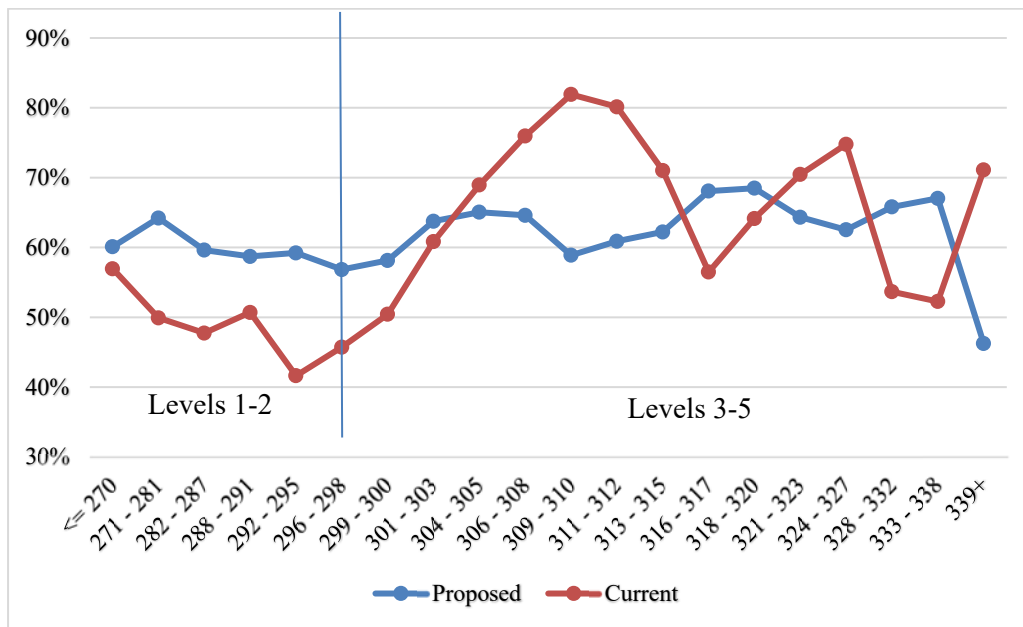

Figure 6. Percentages of Grade 3 Students Making Learning Gains from 2018 to 2019 by 2018 Scale Score Interval

Table 4 compares the effects of the proposed and current definitions of learning gains on the percentages of students demonstrating such gains for the ELL and economically disadvantaged accountability subgroups.

Table 4

Mean Gains in Scale Scores from Grade 3 in 2018 to Grade 4 in 2019 and Corresponding Percentages of Students Making Learning Gains by the Proposed and Current Definitions for Two Accountability Subgroups

Subgroup	Mean Growth	Proposed	Current
FRL	10.8	60%	58%
Non-FRL	10.7	68%	70%
ELL	12.2	62%	60%
Non-ELL	9.7	62%	62%

It can be seen that the differences in learning gain percentages between FRL and non-FRL students were reduced from 12 to 8 percentage points; the differences between ELL and non-ELL learning gain percentages were reduced from 2 to 0 percentage points.

Discussion

One of the current school accountability system components is the percentage of students making learning gains. Under the current system, students can demonstrate a learning gain when advancing by as little as 4 scale score points or even when losing as much as 33 scale score points, while maintaining an Achievement Level 5. We found that the percentage of students in grades 3-9 making learning gains in 2019 had a large variability ranging from 43% of students who were in Achievement Sublevel 1 High to 69% of students who were in the Achievement Level 3 in 2018.

The current definition of making a learning gain makes it is easier to demonstrate learning gains for students who score proficient (within Achievement Levels 3-5). Besides, it has a differential impact on student accountability subgroups: we found that economically disadvantaged students demonstrated a smaller percentage of making learning gains compared with the non-economically disadvantaged counterparts despite making approximately equal gains in scale scores from 2018 to 2019. In addition, we found that ELL students made considerably larger gains in scale score points than their non-ELL peers; yet, their percentage of making learning gains was smaller. Consequently, schools in which ELL and economically disadvantaged subgroups are represented to a large degree were likely to demonstrate smaller learning gains due, at least in part, to the disparate effect of the definition of learning gains on subgroups.

In this report, we propose a definition of learning gains in terms of scale score gains. We used the ELA data for students who advanced from Grade 3 in 2018 to Grade 4 in 2019 to demonstrate how the targets for increases in scale score points can be defined. By using this methodology, we found percentages of students making learning gains were more stable across their initial achievement results and more similar for student accountability subgroups compared with the current definition or learning gains.

Appendix A

On March 13, 2020, Miami Dade County Public Schools were closed to stop the spread of the COVID-19 (Coronavirus) pandemic. Subsequently, on March 17, 2020, Florida Gov. Ron DeSantis announced that the state of Florida was canceling all statewide standardized student assessment for Florida's public K-12 schools for the rest of the 2019-20 school year. The 2019-2020 and school grades will not be issued.

Given that learning gains are a major component in the current school accountability system, the Florida Department of Education will have to address the challenge of determining learning gains in 2021. We think that the methodology described in this Research Brief can be used to establish learning gain targets for two academic years, with a gap year in between, to address this challenge.

We again used quantile regression to calculate the expected amounts of scale score gain in ELA depending on the initial scale scores of those students in Grade 3 through 8 in 2017 who advance by two grade levels by 2018-2019. We fitted the quantile regression for percentiles ranging from 40th to 60th with 5-point increments. We used the already established definition of Achievement Levels and Sublevels and then defined targets for increases in scale score points equal to the means of expected score growth from the quantile regression analysis (based on the 45th percentile for grades 5-9 and the 40th percentile for grade 10). These targets and the resulting percentages of students making learning gains by grade are shown in Table 5 below.

Table 5.
Targets for Growth in FSA ELA Scale Scores from Grades 3-8 in 2017 to Grades 5-10 in 2019 by Students 2017 Achievement Level, the Resulting Percentages of Students Making Learning Gains

| | 2019 Grade Level | | | | | | | | |
| | Grade 5 | | | Grade 6 | | | Grade 7 | | |
2017 Achievement Level	N	Target	Percentage	N	Target	Percentage	N	Target	Percentage
Level 1 Low	406	27	63%	813	24	57%	952	26	61%
Level 1 Middle	904	25	63%	1047	22	52%	1263	22	57%
Level 1 High	1904	23	57%	2638	19	57%	2828	18	54%
Level 2 Low	2547	21	52%	2216	18	53%	2688	15	55%
Level 2 High	2794	21	52%	2757	16	59%	2820	14	56%
Level 3	7185	19	59%	6177	15	58%	5924	11	60%
Level 4	5489	17	63%	4852	13	60%	4843	8	61%
Level 5	2241	15	54%	2117	10	52%	2230	4	57%
Overall	23470		58%	22617		56%	23548		58%

Table 5 (continued).

2017 Achievement Level	2019 Grade Level								
	Grade 8			Grade 9			Grade 10		
	N	Target	Percentage	N	Target	Percentage	N	Target	Percentage
Level 1 Low	1015	27	62%	945	22	58%	3035	18	59%
Level 1 Middle	1160	23	54%	1267	18	57%	3492	15	50%
Level 1 High	2721	19	53%	3152	15	54%	7531	12	52%
Level 2 Low	2540	17	55%	2385	13	56%	4856	10	53%
Level 2 High	2903	15	58%	2385	12	57%	4253	9	55%
Level 3	5084	13	60%	4816	10	58%	7110	7	62%
Level 4	5202	10	64%	4373	8	60%	4458	5	62%
Level 5	1936	7	53%	2666	5	55%	2709	2	66%
Overall	22561								