California Math Outcomes Analysis 2015/16

Grade Levels: 3, 4, 5
ST Math Program: Gen-4
Analysis Type: Three-Year
Treatment-Years: 2013/14, 2014/15, 2015/16
Baseline-Year: 2012/13
Subgroup: All

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Abstract

This analysis covers all grades using ST Math in California in 2015/16. It identifies those grades with nominal or better implementation of the ST Math program, and matches them to randomly selected, similar math-performance, comparison grades. The nominal ST Math users are an aggregation of 99 grades, consisting of grades 3, 4, and 5 at 56 schools, with an average baseline of 72% in Standard Met or Exceeded proficiency levels (refer to Figures 2 and 3 to see how your schools compare to those analyzed in this report). They were matched to 99 similar, randomly selected control grades at 97 schools that never used ST Math. Grade-wise growth in math proficiency was evaluated (i.e. growth in same grade, same school, from 2012/13 to 2015/16) on the percentage proficient, scale scores, and Z-scores of the scale scores (see Section 3.1). Grades 3, 4, and 5 aggregated showed an ST Math effect of 5.4 points at the Standard Met or Exceeded levels, 1.14 points at the Standard Met Level, 4.26 points at the Standard Exceeded Level, and Z-score of 0.19.

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1 Introduction

1.1 Background

This is a quasi-experimental analysis at the grade-mean level. Entire grades represent the units of analysis, and outcome measures are the 3-year changes in grade-mean CAASPP Standard Met or Exceeded percentages. The treatment grades used the ST Math program for 3 years, beginning in the 2013/14 school year. The study hypothesis is treatment grades using ST Math will outperform similar matched control grades, using their "business as usual" conditions of instructional content and professional development. The control grades were selected to have similar demographic and math attributes to the treatment grades during the baseline year (2012/13), and did not use ST Math in 2013/14, 2014/15, and 2015/16. The treatment grades' selection pool was all schools using ST Math in grades 3, 4, and 5 in California. The control grades' pool was all schools not using ST Math in grades 3, 4, and 5 in California. This study method measures effectiveness of the ST Math program when nominally implemented.

1.2 Program Description

The ST Math program is a supplemental math program covering grade-level California math standards. The ST Math content consists of visual representations of math standards, concepts, and procedures, presented to students as "Puzzles" of virtual manipulatives, with which they interact to pose solutions. Each time the student poses a solution, the computer visually animates the Puzzle, diagram, or symbols to show why the posed solution correctly solves, or why it does not solve, the math problem (puzzle). The Puzzles are arranged into sequential groups, called "Levels". To proceed to the next Level in sequence, the student needs to master his/her current Level. Mastering a Level requires solving 100% of the math problems, or Puzzles correctly. In this way, the program is self-paced. Students must correctly solve approximately 4-12 Puzzles, with only 1 failure and retry allowed, to proceed. Levels are sequenced together into Games and, again, the student must master each Game to get to the next Game in sequence. Games are sequenced into "Learning Objectives" (e.g. 'Fractions Concepts'). The ST Math curriculum of approximately 20-25 Learning Objectives can be rearranged in a year-long, grade-level syllabus to match district math pacing through the school year.

The Puzzles typically start with concrete representations of the math, without abstract symbols, math vocabulary, or even English words. Gradually, through subsequent Levels or Games, abstractions are introduced. For example, a Puzzle might start with "n" green blocks on the screen, and then at a subsequent Level may represent the quantity with the numeral for "n" (no green blocks anymore). In this way, three things are accomplished: i) language proficiency prerequisites to engage with the program are minimal, ii) non-mathematical distractions (e.g. back-stories for word problems) are minimized or eliminated – thereby reducing load on working memory, and iii) the actual math in the problem can be represented clearly, simply, and unambiguously.

Besides the self-paced progress made by students in their one-to-one environment, the program is designed to be referenced by teachers during their regular math instruction. It is supplemental to core or basal math instruction and instructional materials. As the great majority of grade-level math standards are covered in the ST Math digital curriculum, completion of 100% of the entire ST Math curriculum (i.e. completing every Game) is required to cover all grade-level math standards.

Teachers receive initial training, either face to face or through self-guided online instruction. The training covers account startup, as well as math learning and growth mindset goals, the pedagogical

approach to learning in a visual experiential game, monitoring and intervention of the student 1:1 game play, and connecting of ST Math content to classroom content and pacing.

To achieve nominal progress through the program, there is a time-on-task requirement. While student progress rates through the program vary, MIND Research Institute has found that consistent application of 90 minutes per week throughout the school year is sufficient to get most students through at least half of the ST Math Learning Objectives. Students are recommended to use the program in school for at least two 45-minute sessions per week, or 90 minutes per week, over about 35 weeks. Analyses of ST Math usage have shown that consistently following this schedule throughout the school year is usually sufficient to achieve 50% or more Progress through ST Math content. Progress is a percentage of ST Math content coverage, and is defined as Levels completed by the student, divided by the total number of Levels in the curriculum. In addition, MIND's historical analyses have shown that it is necessary to complete at least 50% of the program in order to expect significantly higher performance compared to non-users.

2 Data Collection

Since this analysis uses grades as the unit of analysis, and states publish grade-mean state standardized test scores, the data for student math outcomes is collected from each state education agency's research files (retrieved from state websites). The school-level demographic data is also collected from the MDR (Market Data Retrieval, Shelton CT) database. The treatment students use ST Math student accounts served by MIND. Student ST Math usage data is aggregated to grade-level means by MIND.

2.1 Proficiency Levels Definition

The following (Tables 1 and 2) are California's proficiency level descriptions:

Proficiency Level	State Proficiency Level Name
L1	Far Below Basic
L2	Below Basic
L3	Basic
L4	Proficient
L5	Advanced

Table 1: Proficiency Level Naming - 2012/13 - STAR

Proficiency Level	State Proficiency Level Name
L1	Standard Not Met
L2	Standard Nearly Met
L3	Standard Met
L4	Standard Exceeded

Table 2: Proficiency Level Naming - 2015/16 - CAASPP

In order to compare changes in proficiency levels over time, this analysis maps the five old STAR proficiency levels into the four new CAASPP proficiency levels. Based on their definitions,

for 2012/13, the new L1 (Standard Not Met, CAASPP) is equal to the sum of L1 (Far Below Basic STAR) and L2 (Below Basic, STAR). Subsequently, the new L2 (Standard Nearly Met, CAASPP) for 2012/13 is equal to L3 (Basic, STAR), the new L3 (Standard Met, CAASPP) is equal to L4 (Proficient, STAR), and the new L4 (Standard Exceeded, CAASPP) is equal to L5 (Advanced, STAR). Moving forward, this analysis will only be comparing proficiency levels L1, L2, L3, L4, as defined by CAASPP.

2.2 Treatment Grades Pool and Selection

The Treatment grades pool originated with all schools and grades using ST Math in California. From these schools, every grade that had used the ST Math program was identified. They comprise the Treatment grades pool for this evaluation of 3-year usage.

Because the analysis uses grade-mean data, such as grade-mean scale scores or grade-mean proficiency level percentages, it is necessary that the program also be a grade-wide treatment, with the great majority of students in each grade receiving treatment. Otherwise, the grade-means reported by the state of 100% of *tested* students would not be valid measures of a smaller fraction of *treatment* students. MIND's site implementation requirement is that an entire grade, including all teachers and all classes within that grade, use the ST Math program. We validate how closely this is the case for each individual treatment grade by comparing the number of ST Math student accounts at a grade level to the California's reported enrollment at that grade level. We discard from the Treatment pool any grade with a ratio of ST Math student accounts to reported grade enrollment lower than 85%.

Furthermore, the outcomes measure is a summative year-end test, i.e. California's standardized math assessment (CAASPP). The math assessment thus covers all the math standards for that entire grade level. Meanwhile, the ST Math program curriculum (arranged into Learning Objectives) is also aligned to California math standards. To infer that the ST Math content is having a valid effect on student outcomes on the summative assessment, we discard any grade with grade-mean of ST Math Progress for its students lower than 50% by year-end.

Progress is a percentage, and is defined as Levels completed by the student, divided by the total number of Levels in the grade-level curriculum. Note that student achievement of at least 50% progress in ST Math is accomplished primarily by teacher assignment of computer session time to students. With sufficient time on task, students make progress. The program helps them self-pace through providing real-time informative feedback for each puzzle.

2.3 Control Grades Pool and Selection

The control grades are randomly selected from a control pool of schools in California. Though they are randomly selected, they are also matched to be similar to the Treatment grades' math attributes and demographics during the baseline 2012/13 year. The matched attributes include:

- scale score
- student percentages at each math proficiency level
- percentage of students receiving free or reduced lunch (using the demographic data from MDR).

To mitigate the risk of randomly picking a set of Control grades that generates an outlier for effect, a Monte Carlo approach is used to perform many random picks. The control pool's size is large enough that there are many possible "picks" of closely matched control grades.

One hundred randomly matched picks are made and sets of matched control grades are generated. For each set, the quality of the match as well as the math growth of the potential control set is evaluated. Some picked sets have high average math growth, some have low average math growth. From the set of all picks, a median pick is chosen. This avoids either an unlikely overestimate, or underestimate, of the Control grades' growth. When multiple median picks exist, the control set with the minimal math score differences in the baseline year is chosen.

3 Data Analysis

The set of all schools and grades using ST Math in California is evaluated for Enrollment percentage and Progress percentage parameters. A filtered Treatment set (TRT) of all ST Math grades with $\geq 85\%$ Enrollment and $\geq 50\%$ Progress is identified. State math assessment data is tabulated. A matching set of Control grades based on baseline year state math assessment is selected.

Changes in math performance, i.e. the difference in math performance of a grade from a baseline year to the final year, are evaluated and tabulated. Statistical tests of the significance of the difference in math performance changes between Treatment grades and Control grades are performed. Finally, a grade-by-grade disaggregation is performed.

3.1 Z-scores

When states change their state assessment throughout the years, they also change the range of possible scale scores achieved on the exam. This makes it difficult to compare changes in grade mean scale scores across years with a different exam. To deal with this issue, a new Z-score is calculated. For each year being analyzed, by grade, a Z-score takes the difference of the grade mean scale score and the mean of all scale scores statewide for that year, and then divides it by the standard deviation of all scale scores statewide for that year. Here is a fictional example to illustrate the calculation of a Z-score for the 2015/16 exam:

School A, Grade 3, Mean scale score: 300
Average across all schools statewide, Grade 3: 350
Standard deviation across all schools statewide, Grade 3: 30
Z-score=((School A, Grade 3, Mean scale score)-(Average across all schools, Grade 3))/(Standard deviation across all schools, Grade 3)

$$\text{Z-score}=\frac{300-350}{30}=-1.67$$

The Z-score is calculated for every grade across all years being analyzed, using the full state data set of California schools for the averages and standard deviations. The use of Z-scores is a valid statistical method to normalize any dataset and to enable analysis across otherwise uncomparable exams. In this report, we will include both mean scale scores and their accompanying Z-scores.

3.2 Percentile Ranking

These newly calculated z-scores can then be converted into a percentile ranking. Each percentile ranking shows the grade's performance relative to the others in that year and grade. For example, for a specific grade 3, a percentile ranking of 50 shows that this grade 3 performed at the average of all third grades in the state for that testing year.

3.3 Final Treatment and Control

3.3.1 ST Math Grade-Aggregated Implementation (≥ 85% Enrollment Grades Only)

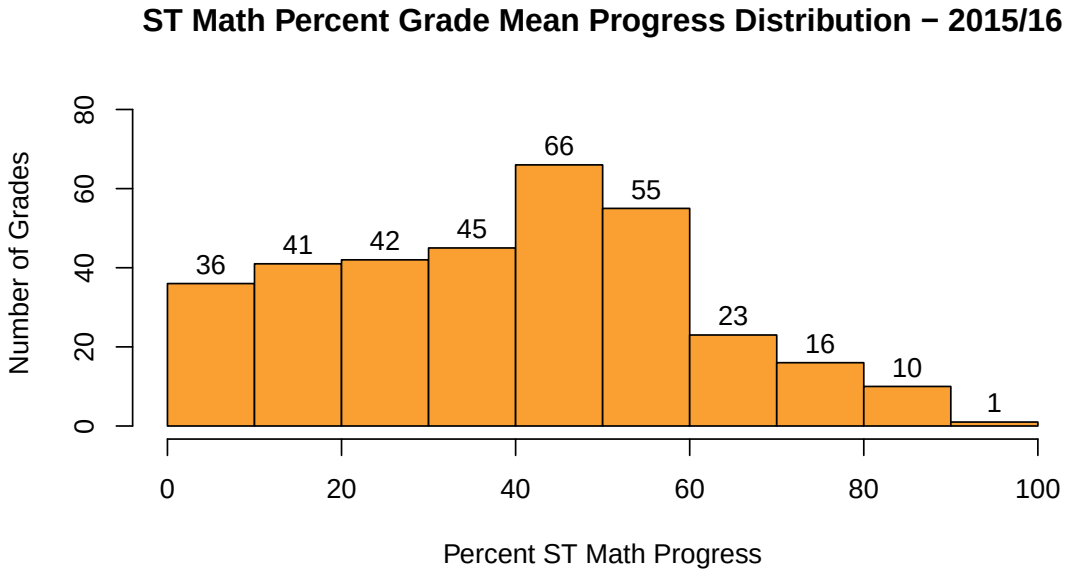

Figure 1: Histogram of ST Math Percent Progress for ≥ 85% Enrollment Grades 2015/16

For all ST Math grades with Enrollment ≥ 85%, Figure 1 shows the frequency distribution of grade-average Progress percentage through the program. Note that we will only be using grades with ≥ 50% Progress as the Treatment Group.

Table 3 provides descriptive statistics of the Progress distribution. Table 4 shows the number of remaining treatment grades after applying enrollment and progress filters.

	Min.	Max.	Average	S.D.
ST Math % Progress	0.0	100.0	39.0	21.3

Table 3: Descriptive Statistics of ST Math Percent Progress for >= 85 percent Enrollment Grades

Grades with >= 85% Enrollment:	307
Grades with in addition >= 50% Progress:	99

Table 4: Number of ST Math Grades with >= 85 percent Enrollment and with >= 50 percent progress

3.3.2 Filtering Treatment and Controls

Table 5 shows the total number of grades in the Treatment pool, the number of grades that exceeded the 85% Enrollment figure, and also the 50% Progress filter. Other rows in the table indicate counts of numbers of students (2015/16 from state testing count) and counts of number of schools represented. The number of matched Control (CTRL) grades, students, and schools is also shown.

	Grade 3	Grade 4	Grade 5	Total
ST Math Using Grades	121	109	105	335
ST Math Using Schools	121	109	105	138
ST Math Students	10464	10256	9480	30200
ST Math Grades (Enroll >= 85%)	114	100	93	307
TRT Grades (Enroll >= 85% & Prog >= 50%)	40	28	31	99
TRT Schools (Enroll >= 85% & Prog >= 50%)	40	28	30	56
TRT Students (Enroll >= 85% & Prog >= 50%)	3833	2826	2874	9533
CTRL Grades	40	28	31	99
CTRL Schools	39	28	31	97
CTRL Students	3562	2416	2520	8498

Table 5: Treatment Pool Filtering and Controls: Counts of Grades, Schools, and Students

3.3.3 Match of Controls to Treatment

Figure 2 shows the density plot of the baseline STAR Math scale scores (left plot) and baseline percent students at STAR Proficient or Advanced (right plot) for treatment grades overlayed on control grades, showing the closeness of the match obtained between Treatment and Control sets of grades in the baseline year, 2012/13.

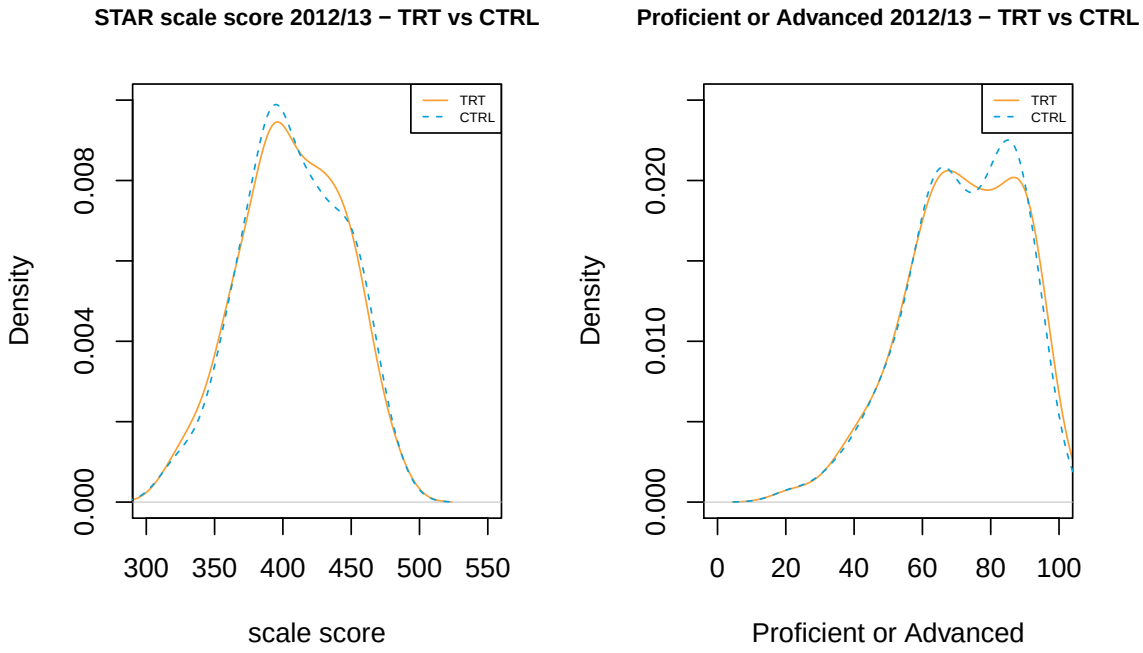

Figure 2: Baseline Year Density Plots Showing Math Scores Match between TRT and CTRL - 2012/13

Similarly, Figure 3 shows the density plot of the percentage of students needing free or reduced lunch for treatment grades overlayed on control grades, showing the closeness of the match obtained between Treatment and Control sets of grades.

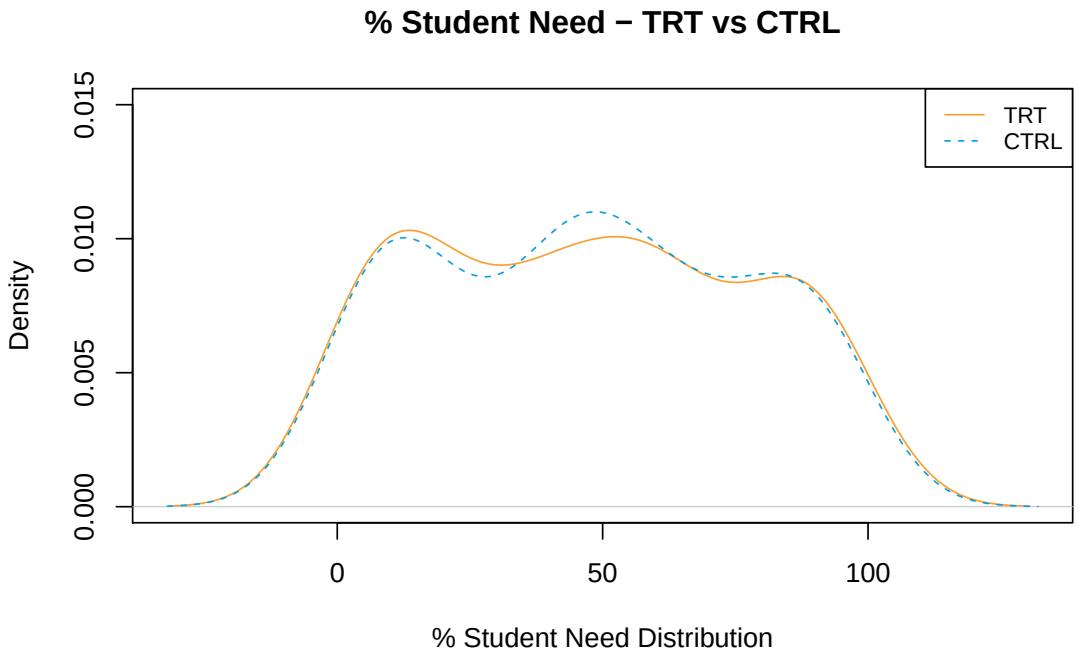

Figure 3: Baseline Year Density Plot Showing Student Need Match between TRT and CTRL

Table 6 shows the difference of the means of Treatment versus Control in the baseline year, with accompanying p-values, for percent Standard Met or Exceeded, for mean scale score, and for percent of students receiving free or reduced lunch. The large p-values show the differences between the Treatment and Control grades are not statistically significant.

	Mean(TRT)	SD(TRT)	Mean(CTRL)	SD(CTRL)	Estimate	P-Value
Proficient or Advanced - 2012/13	71.95	16.45	71.78	16.10	0.17	0.94
Scale score - 2012/13	406.76	37.42	407.39	37.23	-0.63	0.91
Percent Free or Reduced Lunch	47.01	30.19	47.21	29.71	-0.20	0.96

Table 6: Matching TRT and CTRL

3.4 Grade-Aggregated Analysis

Table 7 shows for both Treatment (TRT) and Control (CTRL) aggregation across grades of scale scores, Z-scores, and proficiency level distributions. The far right column also shows the average ST Math Progress for the TRT set.

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Comp.
TRT.12.13	99	56	8437	406.8	0.32	59.43	12.26	15.82	26.47	45.47	71.95	–
TRT.14.15	99	56	8979	2468.6	0.39	62.11	25.61	27.26	26.16	20.93	47.09	57.77
TRT.15.16	99	56	8967	2476.5	0.38	62.38	22.66	26.34	26.49	24.57	51.06	62.61
TRT.Delta	–	–	–	2069.7	0.06	2.95	10.39	10.53	0.02	-20.91	-20.89	–
CTRL.12.13	99	97	8229	407.4	0.34	59.83	11.87	16.42	26.80	44.98	71.78	–
CTRL.14.15	99	97	8546	2458.3	0.22	56.60	29.28	28.30	25.09	17.39	42.48	–
CTRL.15.16	99	97	8498	2465.3	0.21	56.80	26.40	28.05	25.68	19.81	45.48	–
CTRL.Delta	–	–	–	2058.0	-0.13	-3.03	14.54	11.63	-1.12	-25.17	-26.29	–

Table 7: Yearly Math Proficiency and Counts for TRT and CTRL Grade-Aggregated Datasets

The following chart (Figure 4) shows the changes in percentage of students at each math proficiency level for the grade-aggregated Treatment and Control sets (TRT.delta and CTRL.delta).

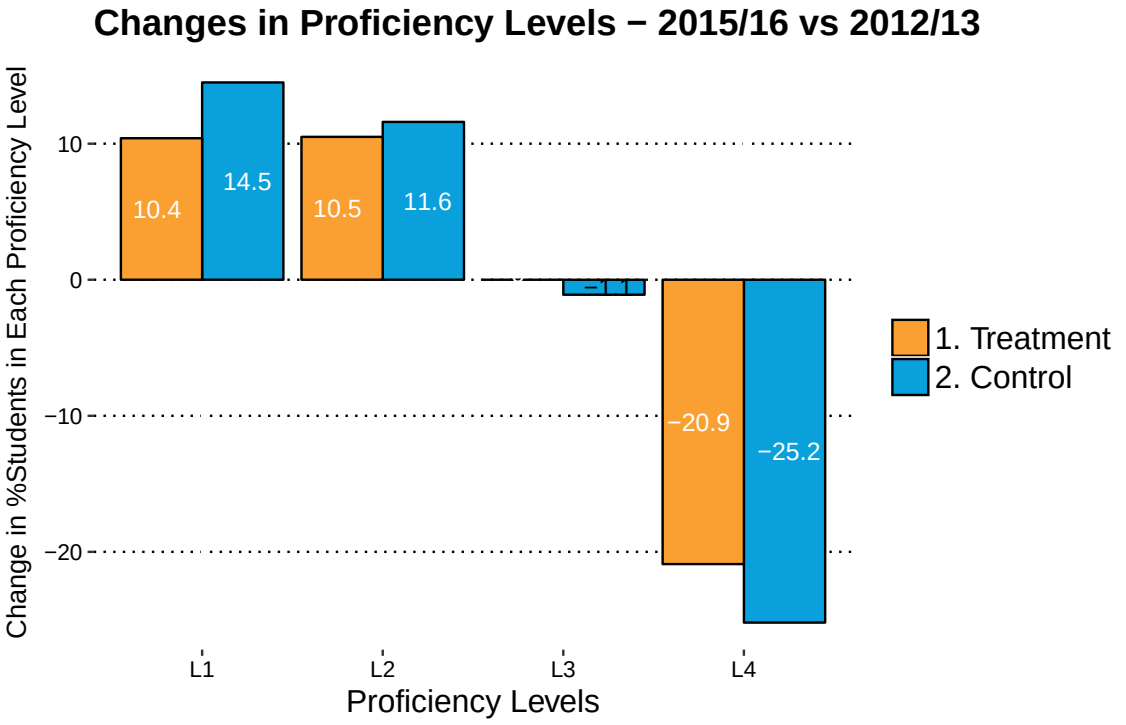

Figure 4: Change between 2012/13 and 2015/16 at each Proficiency Level for Grade-Aggregated TRT and CTRL Datasets

Similarly, Figure 5 shows the changes in CAASPP Math scale scores and changes in Z-scores for the grade-aggregated Treatment and Control sets.

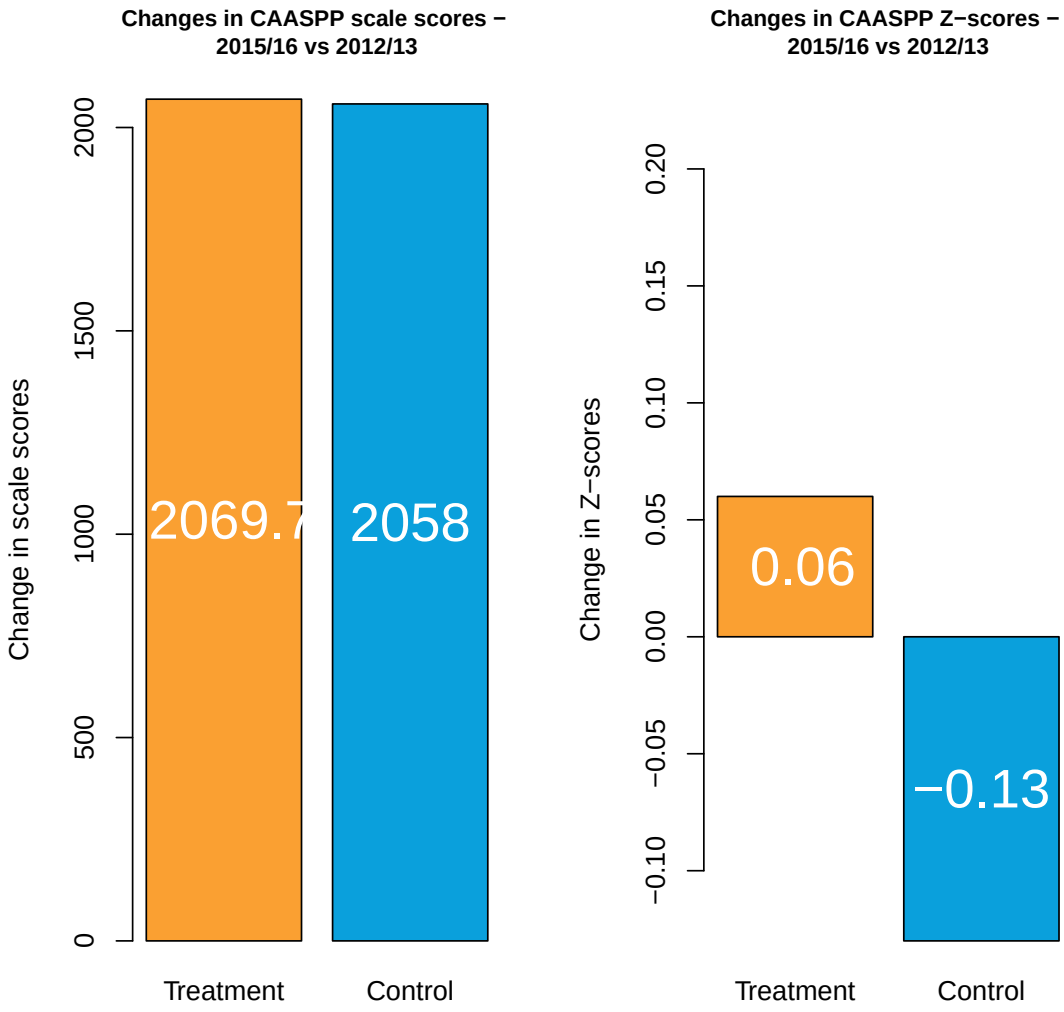

Figure 5: Changes in CAASPP Math scale scores and Z-scores (See Section 3) for Grade-Aggregated TRT and CTRL datasets between 2012/13 and 2015/16

Further, Figure 6 shows the changes in percent of students at CAASPP Standard Met or Exceeded for the grade-aggregated Treatment and Control sets.

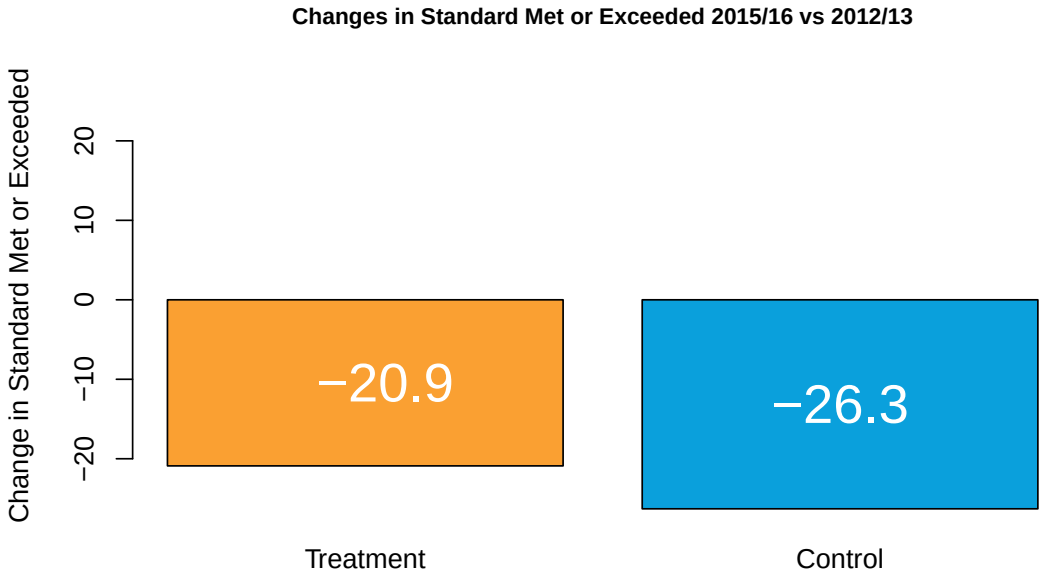

Figure 6: Changes in Standard Met or Exceeded for Grade-Aggregated TRT and CTRL datasets between 2012/13 and 2015/16

Table 8 shows the statistics for the *differences* in changes between TRT and CTRL (Treatment - Control) for these same CAASPP math proficiency and scale score changes as in the above figures. [1]

	Estimate	P-Value	Int.Low	Int.High
Standard Met or Exceeded	5.40	0.01*	1.10	9.71
scale score	11.76	0.04*	0.45	23.06
Z-score	0.19	0.03*	0.02	0.36
L1	-4.14	0.02*	-7.63	-0.65
L2	-1.10	0.44	-3.90	1.70
L3	1.14	0.57	-2.78	5.06
L4	4.26	0.05*	0.02	8.51

Table 8: Statistics for the Differential Changes in Math Scores Growth (TRT - CTRL)

[1] * statistically significant $p<0.05$

Finally, Figure 7 shows the changes in mean percentile ranking between TRT and CTRL.

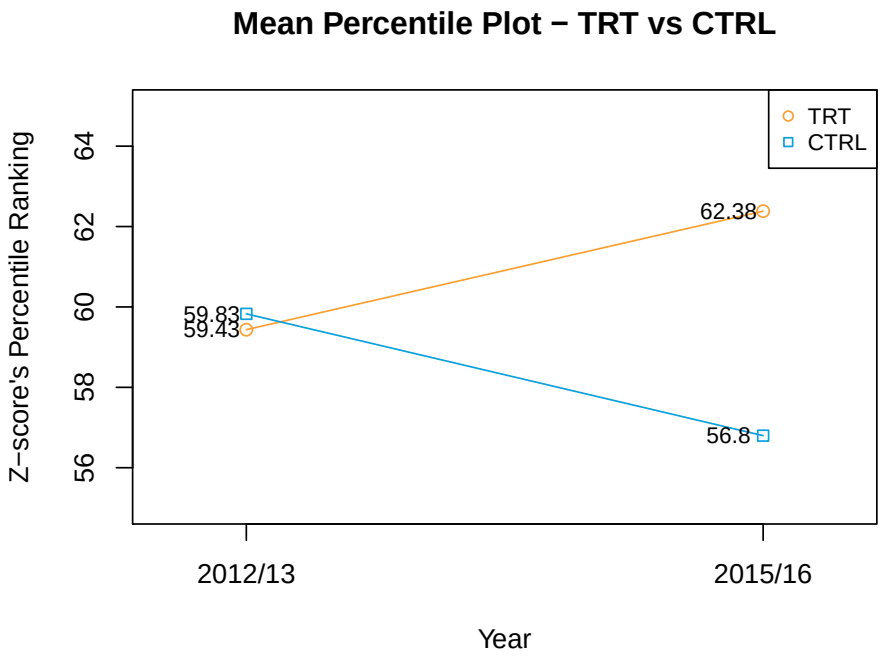

Figure 7: Changes in Percentile Ranking for TRT and CTRL Datasets between 2012/13 and 2015/16

3.5 Grade-Level Analysis

3.5.1 Grade Level Result Tables

The following tables (Table 9, 10, and 11) present a disaggregation of results by grade level. The far right column in each table also shows the average ST Math Progress for the TRT set.

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Prog.
TRT.12.13	40	40	3388	410.0	0.30	58.40	12.25	17.38	24.82	45.62	70.45	–
TRT.14.15	40	40	3567	2435.7	0.41	62.33	24.30	24.32	30.20	21.05	51.25	56.49
TRT.15.16	40	40	3497	2445.3	0.36	62.15	20.95	23.25	30.88	24.90	55.77	63.72
TRT.Delta	–	–	–	2035.2	0.05	3.75	8.70	5.88	6.05	-20.73	-14.68	–
CTRL.12.13	40	39	3498	410.7	0.32	58.88	12.00	16.88	25.73	45.42	71.15	–
CTRL.14.15	40	39	3704	2425.5	0.21	55.30	28.43	24.48	29.02	18.10	47.12	–
CTRL.15.16	40	39	3562	2435.3	0.20	56.20	24.27	24.80	29.50	21.43	50.92	–
CTRL.Delta	–	–	–	2024.6	-0.12	-2.67	12.27	7.93	3.77	-24.00	-20.23	–

Table 9: Grade 3 - Yearly Math Performance and Counts for TRT and CTRL Datasets

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Prog.
TRT.12.13	28	28	2431	407.9	0.43	62.54	9.25	13.04	22.82	54.82	77.64	–
TRT.14.15	28	28	2588	2477.1	0.36	62.07	21.50	31.43	27.04	20.04	47.07	57.67
TRT.15.16	28	28	2680	2487.0	0.44	63.89	18.32	28.54	28.68	24.61	53.29	65.4
TRT.Delta	–	–	–	2079.1	0.01	1.36	9.07	15.50	5.86	-30.21	-24.36	–
CTRL.12.13	28	28	2186	407.9	0.43	62.54	9.50	13.46	23.43	53.71	77.14	–
CTRL.14.15	28	28	2304	2468.7	0.24	58.64	23.75	33.25	27.82	15.39	43.21	–
CTRL.15.16	28	28	2416	2475.4	0.26	58.79	20.57	33.04	28.68	17.46	46.14	–
CTRL.Delta	–	–	–	2067.6	-0.17	-3.75	11.07	19.57	5.25	-36.25	-31.00	–

Table 10: Grade 4 - Yearly Math Performance and Counts for TRT and CTRL Datasets

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Prog.
TRT.12.13	31	30	2618	401.5	0.25	57.97	15.00	16.32	31.90	36.84	68.74	–
TRT.14.15	31	30	2824	2503.2	0.38	61.87	31.00	27.29	20.16	21.58	41.74	59.52
TRT.15.16	31	30	2790	2507.2	0.36	61.32	28.77	28.35	18.87	24.10	42.97	58.67
TRT.Delta	–	–	–	2105.7	0.11	3.35	13.77	12.03	-13.03	-12.74	-25.77	–
CTRL.12.13	31	31	2545	402.7	0.27	58.61	13.84	18.52	31.23	36.52	67.74	–
CTRL.14.15	31	31	2538	2491.2	0.21	56.42	35.39	28.77	17.55	18.29	35.84	–
CTRL.15.16	31	31	2520	2495.0	0.18	55.77	34.42	27.74	18.03	19.84	37.87	–
CTRL.Delta	–	–	–	2092.3	-0.10	-2.84	20.58	9.23	-13.19	-16.68	-29.87	–

Table 11: Grade 5 - Yearly Math Performance and Counts for TRT and CTRL Datasets

3.5.2 Grade-Level Analysis of Changes in Math Standard Met or Exceeded

Figure 8 shows the difference in the growth of percentages of students at math Standard Met or Exceeded, for the TRT and CTRL datasets, disaggregated by grade:

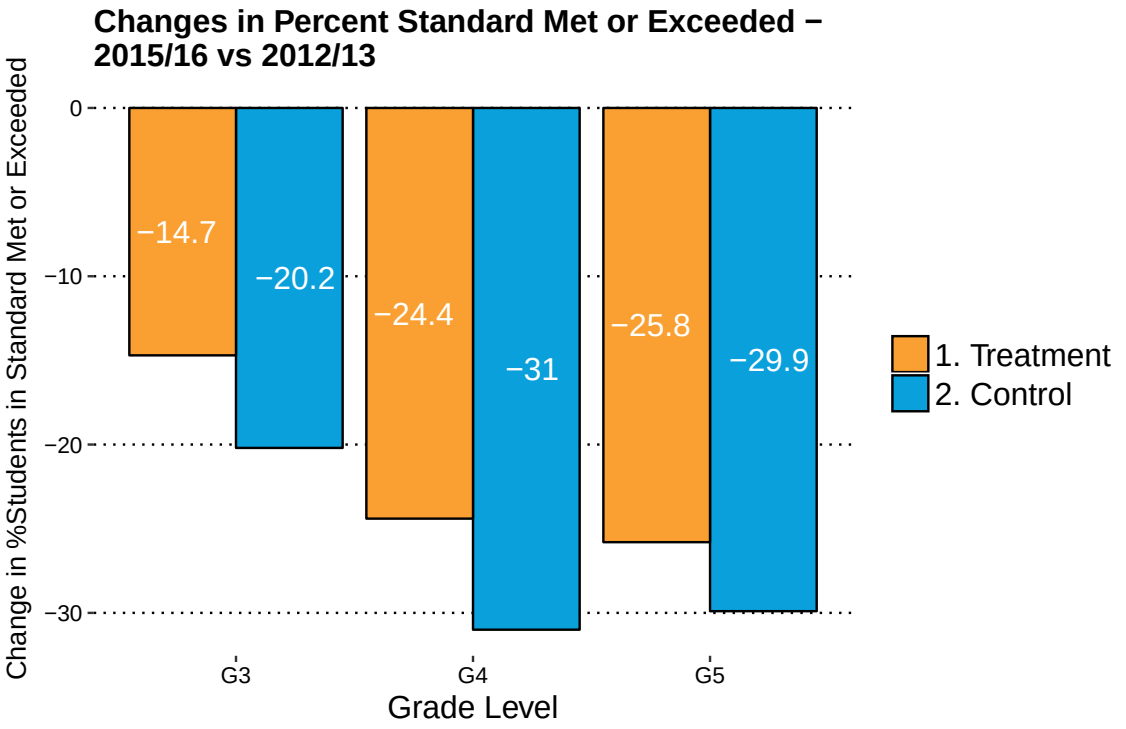

Figure 8: Changes in Percent of Students at Standard Met or Exceeded for TRT and CTRL Datasets between 2012/13 and 2015/16

Table 12 shows the statistics for the *differences* in changes between TRT and CTRL (Treatment - Control) for these same Standard Met or Exceeded math proficiency changes as shown in Figure 8.

	Estimate	P-Value	Int.Low	Int.High
Grade 3	5.55	0.09	-0.83	11.93
Grade 4	6.64	0.13	-2.10	15.38
Grade 5	4.10	0.23	-2.70	10.89

Table 12: Statistics for the Differential Changes in Standard Met or Exceeded , TRT - CTRL

3.5.3 Grade-Level Analysis of Changes in CAASPP Math scale scores

Figure 9 shows the changes in the grade-mean math scale scores of students for the TRT and CTRL datasets, disaggregated by grade:

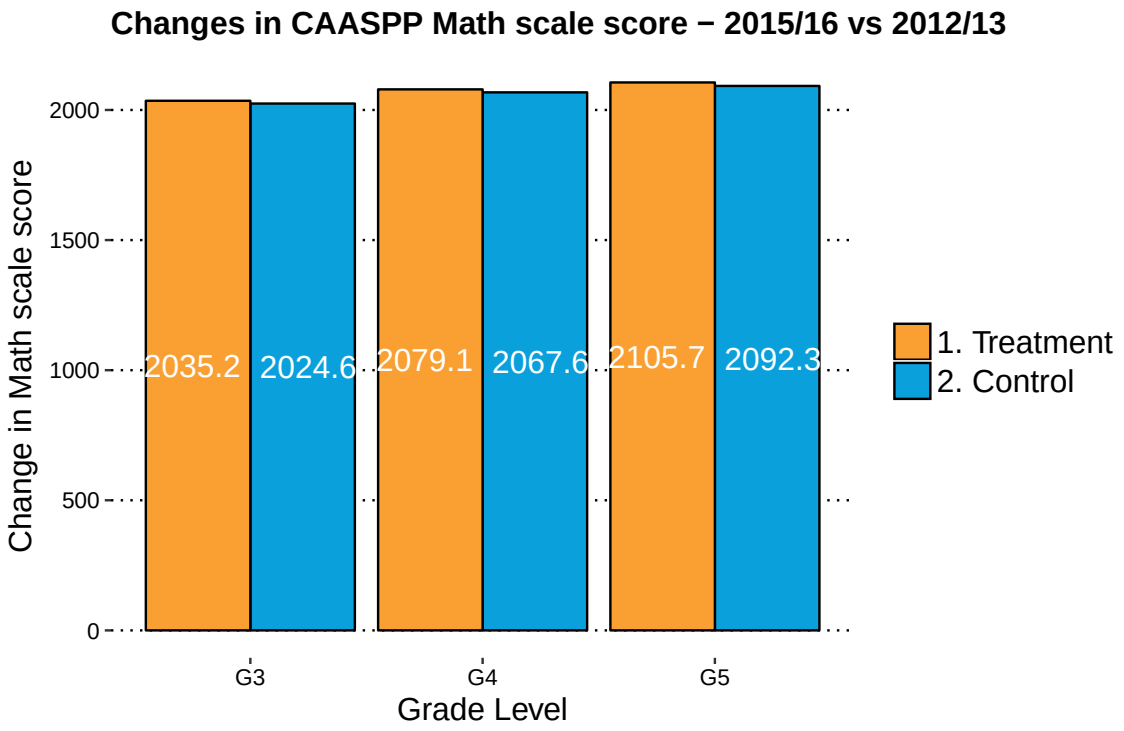

Figure 9: Changes in Grade-Mean CAASPP Math scale score for TRT and CTRL Datasets between 2012/13 and 2015/16

Table 13 shows the statistics for the differences between TRT and CTRL (Treatment - Control) for these same CAASPP math scale score changes as shown in Figure 9.

	Estimate	P-Value	Int.Low	Int.High
Grade 3	10.62	0.08	-1.24	22.47
Grade 4	11.55	0.15	-4.33	27.43
Grade 5	13.42	0.05	-0.10	26.93

Table 13: Statistics for the Differential Changes in CAASPP Math scale scores Growth, TRT - CTRL

3.5.4 Grade-Level Analysis of Changes in CAASPP Z-scores of scale scores

Figure 10 shows the changes in the grade-mean Z-scores of students for the TRT and CTRL datasets, disaggregated by grade:

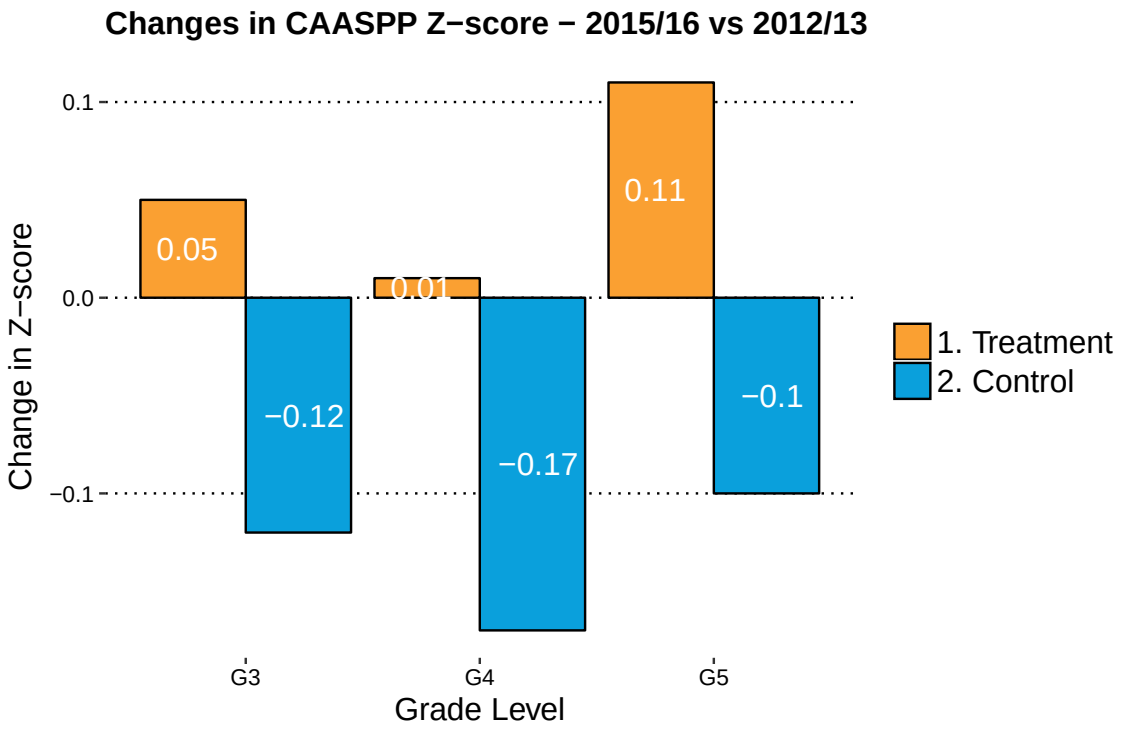

Figure 10: Changes in Grade-Mean CAASPP Z-score (See Section 3) for TRT and CTRL Datasets between 2012/13 and 2015/16

Table 14 shows the statistics for the differences between TRT and CTRL (Treatment - Control) for these same CAASPP Z-score changes as shown in Figure 10.

	Estimate	P-Value	Int.Low	Int.High
Grade 3	0.18	0.20	-0.09	0.45
Grade 4	0.18	0.33	-0.19	0.54
Grade 5	0.21	0.13	-0.06	0.48

Table 14: Statistics for the Differential Changes in CAASPP Z-scores (See Section 3) Growth, TRT - CTRL

4 Effect Size

The following table shows the effect sizes for Standard Met or Exceeded, CAASPP scale score, and accompanying Z-score.

	Scale score Effect Size	Z-score Effect Size	Standard Met or Exceeded Effect Size
Grade 3	0.27	0.19	0.37
Grade 4	0.34	0.19	0.44
Grade 5	0.35	0.24	0.24
All Grades	0.32	0.20	0.34

Table 15: Cohen's d Effect Size

5 Findings Summary

California grades 3, 4, and 5 using ST Math for the year 2015/16 averaged 39% ST Math Progress. 105/335 grades (31%) averaged covering more than 50% of ST Math content. Statistically significant differences were found in this analysis for grade-aggregated results. Looking at Table 8, statistically significant differences were found for grade-aggregated Z-score, with an estimate of 0.19 points favorable for the ST Math treatment set, as well as for grade-aggregated Standard Met or Exceeded proficiency levels, with a 5.4 point favorable differential for the ST Math treatment set. Further, in Table 8, grade-aggregated ST Math treatment set outperformed their matched controls at the Standard Exceeded level, with a statistically significant difference of 4.26.

6 Confounders

Despite best efforts in minimizing confounders to the results of this analysis, there still remain a few input variables that could be significant in affecting differences of state test score outcomes between the Treatment and Control sets. One issue is the lack of randomization of grades chosen to receive the ST Math treatment. Instead of randomized selection, Treatment grades are self-selected. Self-selection can be an indication of districts or schools with a focus on math, an appetite for change, and with a spotlight on math training. Furthermore, not all grades using the ST Math program are chosen for analysis. Each grade must pass two specific filters to be considered for the Treatment set: the first being an enrollment filter of at least 85% of students in each grade using the program, and the second being a progress filter of at least 50% of the program completed on average by students in that grade. These filters might indicate relatively high-functioning schools with a team of relatively effective teachers in that grade, thus resulting in better instruction overall. A mitigation of this possible confounder is our selection of treatment groups on the grade level, rather than the teacher level, so there is no cherry picking of teachers: the full range of teachers in each grade is included. Moreover, the specific teachers may often be the same in the baseline year as in the current year, so the Treatment growth is not due to teacher differences. Finally, a possible confounder lies in the "business as usual" conditions at the matched control grades chosen for each analysis. It's unknown whether these control grades used other programs that could affect the comparison of the two sets of grades. The Monte Carlo Method is used to mitigate the possibility of control picks being favorable or unfavorable (see Section 2.3).

7 Reference Tables Grouped By School Year

The following tables show grade-level details, grouped by school year and for treatment (Table 16) and controls (Table 17) separately.

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Comp.
Grade 3 (12.13)	40	40	3388	410.0	0.30	58.40	12.25	17.38	24.82	45.62	70.45	–
Grade 4 (12.13)	28	28	2431	407.9	0.43	62.54	9.25	13.04	22.82	54.82	77.64	–
Grade 5 (12.13)	31	30	2618	401.5	0.25	57.97	15.00	16.32	31.90	36.84	68.74	–
All Grades (12.13)	99	56	8437	406.8	0.32	59.43	12.26	15.82	26.47	45.47	71.95	–
Grade 3 (14.15)	40	40	3567	2435.7	0.41	62.33	24.30	24.32	30.20	21.05	51.25	56.49
Grade 4 (14.15)	28	28	2588	2477.1	0.36	62.07	21.50	31.43	27.04	20.04	47.07	57.67
Grade 5 (14.15)	31	30	2824	2503.2	0.38	61.87	31.00	27.29	20.16	21.58	41.74	59.52
All Grades (14.15)	99	56	8979	2468.6	0.39	62.11	25.61	27.26	26.16	20.93	47.09	57.77
Grade 3 (15.16)	40	40	3497	2445.3	0.36	62.15	20.95	23.25	30.88	24.90	55.77	63.72
Grade 4 (15.16)	28	28	2680	2487.0	0.44	63.89	18.32	28.54	28.68	24.61	53.29	65.4
Grade 5 (15.16)	31	30	2790	2507.2	0.36	61.32	28.77	28.35	18.87	24.10	42.97	58.67
All Grades (15.16)	99	56	8967	2476.5	0.38	62.38	22.66	26.34	26.49	24.57	51.06	62.61

Table 16: TRT Grades Detail Sorted by Year

	# Grades	# Schools	# Students	Scale score	Z-score	Percentile	L1	L2	L3	L4	Standard Met or Exceeded	ST Math Per Comp.
Grade 3 (12.13)	40	39	3498	410.7	0.32	58.88	12.00	16.88	25.73	45.42	71.15	–
Grade 4 (12.13)	28	28	2186	407.9	0.43	62.54	9.50	13.46	23.43	53.71	77.14	–
Grade 5 (12.13)	31	31	2545	402.7	0.27	58.61	13.84	18.52	31.23	36.52	67.74	–
All Grades (12.13)	99	97	8229	407.4	0.34	59.83	11.87	16.42	26.80	44.98	71.78	–
Grade 3 (14.15)	40	39	3704	2425.5	0.21	55.30	28.43	24.48	29.02	18.10	47.12	–
Grade 4 (14.15)	28	28	2304	2468.7	0.24	58.64	23.75	33.25	27.82	15.39	43.21	–
Grade 5 (14.15)	31	31	2538	2491.2	0.21	56.42	35.39	28.77	17.55	18.29	35.84	–
All Grades (14.15)	99	97	8546	2458.3	0.22	56.60	29.28	28.30	25.09	17.39	42.48	–
Grade 3 (15.16)	40	39	3562	2435.3	0.20	56.20	24.27	24.80	29.50	21.43	50.92	–
Grade 4 (15.16)	28	28	2416	2475.4	0.26	58.79	20.57	33.04	28.68	17.46	46.14	–
Grade 5 (15.16)	31	31	2520	2495.0	0.18	55.77	34.42	27.74	18.03	19.84	37.87	–
All Grades (15.16)	99	97	8498	2465.3	0.21	56.80	26.40	28.05	25.68	19.81	45.48	–

Table 17: CTRL Grades Detail Sorted by Year

8 Lists of Schools

8.1 Treatment Schools

The following tables list the treatment schools and grades (after 85% enrollment and 50% progress filtering) used in the analysis.

PID	IID	District	School Name	GRADE
90172	AND7D1	Anderson Valley Unified School District	Anderson Valley Elementary	3
66080	CHA72Q	Azusa Unified School District	Charles H. Lee Elementary	5
66133	GLA72Q	Azusa Unified School District	Gladstone Street Elementary	3
66195	PAR72Q	Azusa Unified School District	Paramount Elementary	3
66212	VAL72Q	Azusa Unified School District	Valleydale Elementary	3
66224	VIC72Q	Azusa Unified School District	Victor F. Hodge Elementary	3
95005	ART6ZQ	Buena Park Elementary	Arthur F. Corey Elementary	5
110198	AVO73E	Cajon Valley Union	Avocado Elementary	4
110227	CHA73M	Cajon Valley Union	Chase Avenue Elementary	4
110239	CRE73M	Cajon Valley Union	Crest Elementary	3, 4, 5
110265	FLY73M	Cajon Valley Union	Flying Hills Elementary	3
4015514	JAM73L	Cajon Valley Union	Jamacha Elementary	3, 4, 5
110320	MAD73L	Cajon Valley Union	Madison Avenue Elementary	3
110344	MER73L	Cajon Valley Union	Meridian Elementary	3, 4, 5
110368	NAR73M	Cajon Valley Union	Naranca Elementary	5
2896805	RAN73L	Cajon Valley Union	Rancho San Diego Elementary	3, 5
2129652	VIS73L	Cajon Valley Union	Vista Grande Elementary	4
110382	WDH73M	Cajon Valley Union	W. D. Hall Elementary	3, 4, 5
110332, 66169	MAG73M, MAG72Q	Cajon Valley Union, Azusa Unified School District	Magnolia Elementary	4, 5, 5
4947216	MAR75F	Capistrano Unified School District	Marblehead Elementary	3, 4, 5
110409	ADA73K	Cardiff Elementary	Ada W. Harris Elementary	3
110411	CAR73K	Cardiff Elementary	Cardiff Elementary	3
4032938	CEN75S	Centralia Elementary	Centralia Elementary	3, 4
4915794	ELC73K	Encinitas Union Elementary	El Camino Creek Elementary	3
3008764	LAC73K	Encinitas Union Elementary	La Costa Heights Elementary	3, 4, 5
3275498	MIS73K	Encinitas Union Elementary	Mission Estancia Elementary	3, 4, 5
4278493	OLI73K	Encinitas Union Elementary	Olivenhain Pioneer Elementary	3, 4, 5
1397741	PAR73M	Encinitas Union Elementary	Park Dale Lane Elementary	3, 4, 5
110928	PAU73M	Encinitas Union Elementary	Paul Ecke-Central Elementary	3, 4
96750	AGN75C	Huntington Beach City Elementary	Agnes L. Smith Elementary	3, 4
4749076	JOH75C	Huntington Beach City Elementary	John R. Peterson Elementary	3, 4, 5
96827	RAL75C	Huntington Beach City Elementary	Ralph E. Hawes Elementary	3, 4, 5
1397624	SAM75C	Huntington Beach City Elementary	S. A. Moffett Elementary	3, 4, 5
2105905	NOR75A	Irvine Unified	Northwood Elementary	5
98667	VIS758	Irvine Unified	Vista Verde	5
11132313	KIP6Y3	Kipp Raices Academy	Kipp Raices Academy	4
71889	LOS708	Long Beach Unified School District	Los Cerritos Elementary	5
72106	TIN709	Long Beach Unified School District	Tincher Preparatory	3, 4, 5
72780	HAR6Z0	Los Angeles Unified	Harbor City Elementary	3
76425	MIC6Y2	Los Angeles Unified	Micheltorena Street Elementary	3, 4, 5
73370	MIL6YP	Los Angeles Unified	Miles Avenue Elementary	3
73409	NIN6Y1	Los Angeles Unified	Ninety-Second Street Elementary	3, 4, 5
73411	NIN6Y0	Los Angeles Unified	Ninety-Sixth Street Elementary	3
73033	VAN6ZE	Los Angeles Unified	Van Deene Avenue Elementary	5
50093	PLA7AS	Oakland Unified School District	Preparatory Literary Academy Of Cultural Excellenc	3
49965, 71645	GAR7AS, GAR70A	Oakland Unified School District, Long Beach Unified School District	Garfield Elementary	3, 4, 5
104826	PAC7E6	Sacramento City Unified	Pacific Elementary	4, 5
113578	MCK73U	San Diego Unified School District	Mckinley Elementary	3
98863	ROO75I	Santa Ana Unified School District	Theodore Roosevelt Elementary	5
128999	CUM79C	Sunnyvale	Cumberland Elementary	3
128937	ELL79C	Sunnyvale	Ellis Elementary	3
4756639	FAI79C	Sunnyvale	Fairwood Elementary	4
4020428	BRE73S	Vista Unified	Breeze Hill Elementary	3
114845	CAS73S	Vista Unified	Casita Center For Science/Math/Technology	3, 4, 5
5274581	TEM73P	Vista Unified	Temple Heights Elementary	4, 5

Table 18: Treatment Schools (TRT Dataset)

PID	IID	District	School Name	GRADE
83143	DAN6ZO	Whittier City Elementary	Daniel Phelan Elementary	3, 5

Table 19: Treatment Schools (TRT Dataset)

8.2 Control Schools

The following tables list the control schools and grades (matched control grades to treatment grades) used in the analysis.

PID	District	School Name	GRADE
47321	Albany City Unified School District	Cornell Elementary	4
2130780	Alisal Union School District	Frank Paul Elementary	5
4754813	Alta Loma Elementary	Banyan Elementary	5
2180345	Arvin Union School District	Bear Mountain Elementary	3
4286933	Bakersfield City School District	Cesar E. Chavez Elementary	3
62333	Beardsley Elementary School District	Beardsley Elementary	4
3399238	Beaumont Unified School District	Anna Hause Elementary	3
66626	Bellflower Unified School District	Esther Lindstrom Elementary	5
66729	Bellflower Unified School District	Thomas Jefferson Elementary	3
5278848	Buckeye Union Elementary School District	Oak Meadow Elementary	4
4009216	Buckeye Union Elementary School District	Silva Valley Elementary	3
52998	Calaveras Unified School District	West Point Elementary	3
125349	Campbell Union	Blackford Elementary	3
110473	Carlsbad Unified	Magnolia Elementary	4
1878757	Central Elementary School District	Dona Merced Elementary	3
1169506	Charter Oak Unified School District	Badillo Elementary	4
4035344	Chico Unified School District	Emma Wilson Elementary	3
4286983	Chino Valley Unified	Country Springs Elementary	3
10912196	Chula Vista Elementary School District	Wolf Canyon Elementary	3
67436, 4947204	Claremont Unified School District, Capistrano Unified School District	Chaparral Elementary	3, 3
4033920	Clovis Unified School District	Garfield Elementary	4
123884	Cold Spring Elementary	Cold Spring Elementary	3
3473523	Desert Sands Unified School District	Gerald R. Ford Elementary	3
4745707	Dublin Unified	Dublin Elementary	3
68753	East Whittier City Elementary	Murphy Ranch Elementary	4
61298	El Centro Elementary School District	Mckinley Elementary	3
4906652	El Segundo Unified School District	Richmond Street Elementary	3
119041	Escalon Unified School District	Van Allen Elementary	5
3250943	Escondido Union School District	L. R. Green Elementary	5
4946365	Etiwanda Elementary	John L. Golden Elementary	3
103494	Galt Joint Union Elementary School Distr	Valley Oaks Elementary	3
69496	Glendale Unified	Balboa Elementary	3
69719	Glendale Unified	Mountain Avenue Elementary	5
4290025	Harriet Tubman Village Charter	Harriet Tubman Village Charter	4
1168825	Hayward Unified School District	Burbank Elementary	4
4243644	Jamul-Dulzura Union Elementary	Jamul Intermediate	4
111477	Lakeside Union Elementary	Lindo Park Elementary	5
72120	Long Beach Unified School District	Twain Elementary	4, 3
72508	Los Angeles Unified	Bonita Street Elementary	4
74013	Los Angeles Unified	Paseo Del Rey Fundamental	3
75093	Los Angeles Unified	Virginia Road Elementary	3
10022648	Lucia Mar Unified School District	Lange (Dorothea) Elementary	3
119704	Manteca Unified	Shasta Elementary	3
133786	Mark West Union Elementary School Distri	San Miguel Elementary	4
122397	Millbrae Elementary	Meadows Elementary	5
3011876	Modesto City Elementary	Alberta Martone Elementary	3
3250993	Moreno Valley Unified School District	Box Springs Elementary	4
3018769	Moreno Valley Unified School District	Creekside Elementary	3
111831	Mountain Empire Unified	Campo Elementary	3
54415	Mt. Diablo Unified School District	Westwood Elementary	5
93667	Napa Valley Unified	Shearer Elementary	3
5350604	Natomas Unified	Witter Ranch Elementary	5
79817	Norwalk-La Mirada Unified	Julia B. Morrison Elementary	5
49563	Oakland Unified School District	Chabot Elementary	5
10016974	Ocean Grove Charter	Ocean Grove Charter	4

Table 20: Matched Control Schools (CTRL Dataset)

PID	District	School Name	GRADE
108327	Ontario-Montclair	Elderberry Elementary	3
130198	Pajaro Valley Unified School District	T. S. Macquiddy Elementary	5
102103	Palm Springs Unified	Cielo Vista Charter	4
80086	Palos Verdes Peninsula Unified School Di	Lunada Bay Elementary	5
80191	Palos Verdes Peninsula Unified School Di	Rancho Vista Elementary	3
91413	Planada Elementary	Planada Elementary	3
1168198	Redding Elementary School District	Bonny View Elementary	4
137196	Richfield Elementary	Richfield Elementary	4
102347	Riverside Unified School District	Alcott Elementary	4
81494	Rowland Unified	Yorbita Elementary	5
92807	Salinas City Elementary	Monterey Park Elementary	5
109046	San Bernardino City Unified	Belvedere Elementary	4
109319	San Bernardino City Unified	Howard Inghram Elementary	3
109345	San Bernardino City Unified	North Park Elementary	5
112691	San Diego Unified School District	Bird Rock Elementary	3
112823	San Diego Unified School District	Clay Elementary	4
113190	San Diego Unified School District	Hardy Elementary	5
114077	San Diego Unified School District	Webster Elementary	5
116477	San Francisco Unified School District	Mccoppin (Frank) Elementary	5
116972	San Francisco Unified School District	Miraloma Elementary	4
1826912	San Francisco Unified School District	New Traditions Elementary	5
81573	San Gabriel Unified	Wilson Elementary	4
1541693	San Juan Unified	Woodside K-8	5
123080	San Mateo-Foster City School District	College Park Elementary	3
1169673	San Rafael City Elementary	Glenwood Elementary	5
55419	San Ramon Valley Unified School District	John Baldwin Elementary	4
55457	San Ramon Valley Unified School District	Neil A. Armstrong Elementary	3
124668	Santa Barbara Unified	Monroe Elementary	5
81858	Saugus Union School District	Highlands Elementary	5
4323270	Saugus Union School District	Mountainview Elementary	5
130435	Scotts Valley Unified School District	Brook Knoll Elementary	4
139417	Sonora Elementary	Sonora Elementary	4
4021800	Sylvan Union Elementary	Orchard Elementary	5
1558581	Temecula Valley Unified School District	Vail Elementary	4
138621	Three Rivers Union Elementary	Three Rivers Elementary	3
10004438	Turlock Unified	Sandra Tovar Medeiros Elementary	5
90445	Ukiah Unified School District	Frank Zeek Elementary	5
3393325	Vallejo City Unified School District	Joseph H. Wardlaw Elementary	3
10024476	Visalia Unified School District	Cottonwood Creek Elementary	3
55550	Walnut Creek Elementary School District	Murwood Elementary	5
134625	Waugh Elementary School District	Meadow Elementary	4
10902103	Weaver Union School District	Farmdale Elementary	5

Table 21: Matched Control Schools (CTRL Dataset)