

Colorado Math Outcomes Analysis 2014/15

Grade Levels: 3, 4, 5

ST Math Program: Gen-4

Analysis Type: Z-score of proficiency

Treatment-Years: 2011/12, 2012/13, 2013/14, 2014/15

Baseline-Year: 2010/11

Subgroup: All

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Abstract

This analysis covers all grades using ST Math in Colorado in 2014/15. 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 70 grades, consisting of grades 3, 4, and 5 at 31 schools, with an average baseline of 70% in Met or Exceeded Expectations proficiency levels (refer to Figures 2 and 3 to see how your schools compare to those analyzed in this report). They were matched to 70 similar, randomly selected control grades at 65 schools that never used ST Math. Grade-wise growth in math proficiency was evaluated (i.e. growth in same grade, same school, from 2010/11 to 2014/15) on the percentage proficient, and z-scores of math proficiency (see Section 3.1). Grades 3, 4, and 5 aggregated showed an ST Math effect of 3.63 points at the Met or Exceeded Expectations levels and z-score of 0.2.

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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 4-year changes in grade-mean PARCC Met or Exceeded Expectations percentages. The treatment grades used the ST Math program for 4 years, beginning in the 2011/12 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 (2010/11), and did not use ST Math in 2011/12, 2012/13, 2013/14, and 2014/15. The treatment grades’ selection pool was all schools using ST Math in grades 3, 4, and 5 in Colorado. The control grades’ pool was all schools not using ST Math in grades 3, 4, and 5 in Colorado. 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 Colorado 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) is Colorado’s proficiency level descriptions:

Proficiency Level	State Proficiency Level Name
L1	Unsatisfactory
L2	Partially Proficient
L3	Proficient
L4	Advanced

Table 1: TCAP: Proficiency Level Naming (2011/12-2013/14)

Proficiency Level	State Proficiency Level Name
L1	Did Not Yet Meet Expectations
L2	Partially Met Expectations
L3	Approached Expectations
L4	Met Expectations
L5	Exceeded Expectations

Table 2: PARCC: Proficiency Level Naming (2014/15)

2.2 Treatment Grades Pool and Selection

The Treatment grades pool originated with all schools and grades using ST Math in Colorado. From these schools, every grade that had used the ST Math program was identified. They comprise the Treatment grades pool for this evaluation of 4-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 Colorado’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. Colorado’s standardized math assessment (PARCC). 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 Colorado 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 Colorado. Though they are randomly selected, they are also matched to be similar to the Treatment grades’ math attributes and demographics during the baseline 2010/11 year. The matched attributes include:

- 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 Colorado 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

In order to analyze across all states with different math assessments, a new z-score of that test's math proficiency is calculated. For each year being analyzed, by grade, a z-score takes the difference of the grade mean percent proficient and the mean of all percent proficient statewide for that year, and then divides it by the standard deviation of all percent proficient statewide for that year. Here is a fictional example to illustrate the calculation of a z-score for the 2015/16 exam:

$$\begin{aligned} &\text{School A, Grade 3, Percent Proficient: } 70 \\ &\text{Average across all schools statewide, Grade 3: } 50 \\ &\text{Standard deviation across all schools statewide, Grade 3: } 20 \\ &\text{Z-score} = \frac{(\text{School A, Grade 3, Percent Proficient}) - (\text{Average across all schools, Grade 3})}{(\text{Standard deviation across all schools, Grade 3})} \end{aligned}$$

$$\text{Z-score} = \frac{70 - 50}{20} = 1$$

The z-score is calculated for every grade across all years being analyzed, using the full state data set of 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 only analyze 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 ($\geq 85\%$ Enrollment Grades Only)

ST Math Percent Grade Mean Progress Distribution – 2014/15

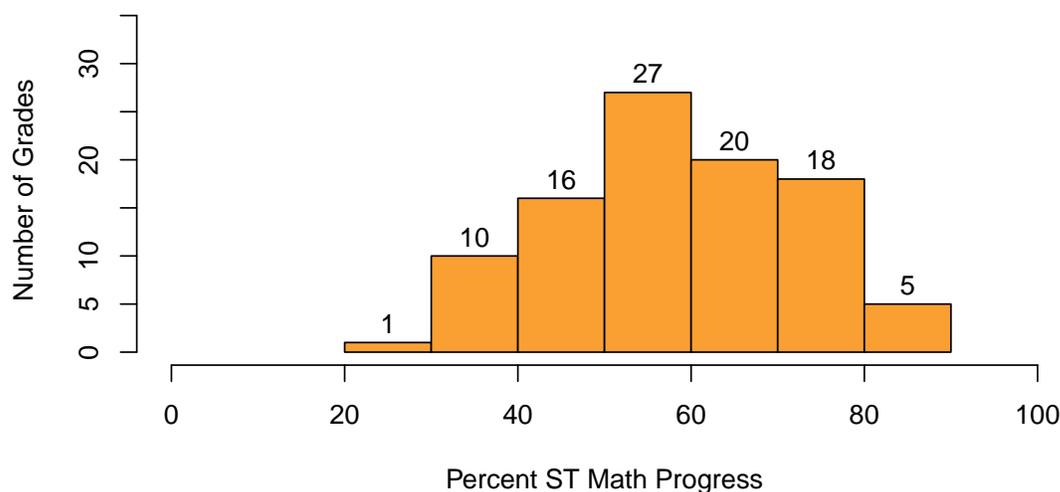


Figure 1: Histogram of ST Math Percent Progress for $\geq 85\%$ Enrollment Grades 2014/15

For all ST Math grades with Enrollment $\geq 85\%$, Figure 1 shows the frequency distribution of grade-average Progress percentage through the program. Note that we will only be using grades with $\geq 50\%$ 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	20.9	86.2	58.3	14.2

Table 3: Descriptive Statistics of ST Math Percent Progress for $\geq 85\%$ Enrollment Grades

Grades with $\geq 85\%$ Enrollment:	97
Grades with in addition $\geq 50\%$ Progress:	70

Table 4: Number of ST Math Grades with $\geq 85\%$ Enrollment and with $\geq 50\%$ 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 (2014/15 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	33	31	33	97
ST Math Using Schools	33	31	33	33
ST Math Students	1928	1730	1787	5445
ST Math Grades (Enroll \geq 85%)	33	31	33	97
TRT Grades (Enroll \geq 85% & Prog \geq 50%)	25	20	25	70
TRT Schools (Enroll \geq 85% & Prog \geq 50%)	25	20	25	31
TRT Students (Enroll \geq 85% & Prog \geq 50%)	1732	1319	1558	4609
CTRL Grades	25	20	25	70
CTRL Schools	25	20	25	65
CTRL Students	1640	1442	1556	4638

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 percent students at TCAP Proficient or Advanced 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, 2010/11.

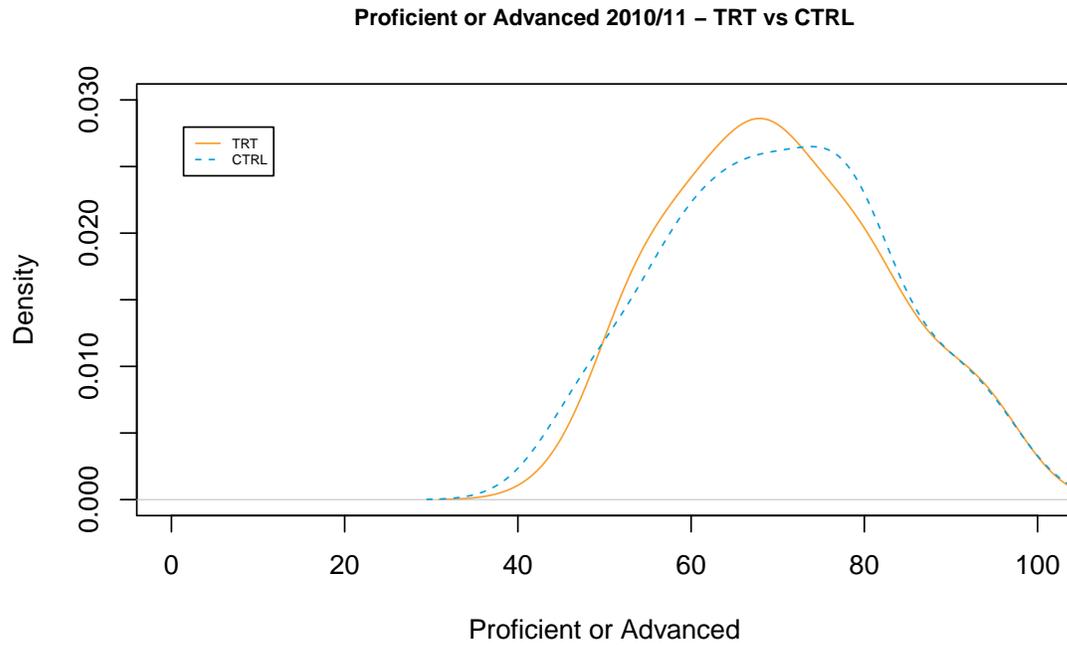


Figure 2: Baseline Year Density Plots Showing Math Scores Match between TRT and CTRL - 2010/11

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

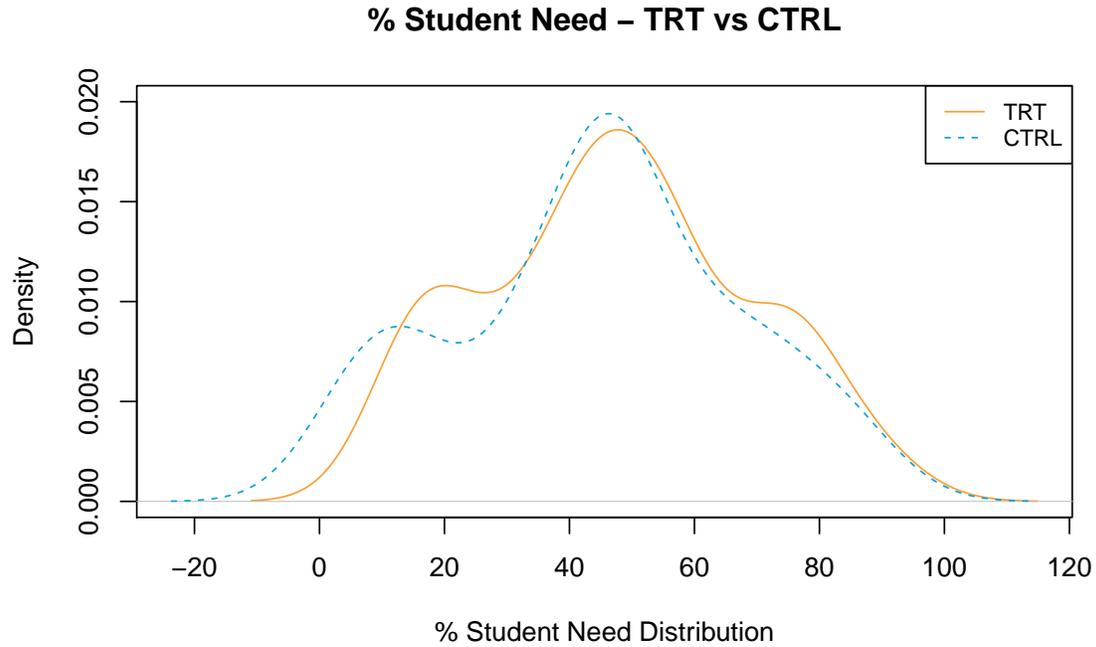


Figure 3: Baseline Year Density Plot Showing Student Need Match between TRT and CTRL

Table 6 shows the difference of the means of Treatment versus Control in the baseline year, with accompanying p-values, for percent Proficient or Advanced 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 - 2010/11	70.08	12.48	70.14	12.94	-0.06	0.98
Percent Free or Reduced Lunch	47.40	21.07	44.41	22.66	2.99	0.42

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 proficiency level distributions and associated z-scores. The far right column also shows the average ST Math Progress for the TRT set.

	# Grades	# Schools	# Students	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Comp.
TRT.10.11	70	31	4241	7.23	22.69	41.79	28.29	70.08	0.11	53.17	-
TRT.11.12	70	31	4211	6.14	21.48	41.29	31.09	72.38	0.23	57.46	73.36
TRT.12.13	70	31	4136	5.75	20.8	44.56	28.89	73.45	0.26	59.04	78.9
TRT.13.14	70	31	4047	6.26	21.05	42.34	30.36	72.69	0.25	58.14	75.02
TRT.14.15	70	31	3958	-	-	-	-	34.98	0.11	52.64	65.24
TRT.Delta	-	-	-	-	-	-	-	-35.10	0.00	-0.53	-
CTRL.10.11	70	65	4608	7.16	22.7	41.65	28.49	70.14	0.11	53.43	-
CTRL.11.12	70	65	4673	7.63	22.79	39.58	30	69.58	0.08	53.41	-
CTRL.12.13	70	65	4737	8.08	21.72	39.91	30.29	70.20	0.08	52.87	-
CTRL.13.14	70	65	4622	7.55	22.53	41.11	28.81	69.92	0.09	53.71	-
CTRL.14.15	70	65	4638	-	-	-	-	31.41	-0.09	45.64	-
CTRL.Delta	-	-	-	-	-	-	-	-38.73	-0.20	-7.79	-

Table 7: All Grades Together Growth

Figure 4 shows the changes in percent of students at PARCC Met or Exceeded Expectations and the accompanying z-scores of math proficiency for the grade-aggregated Treatment and Control sets.

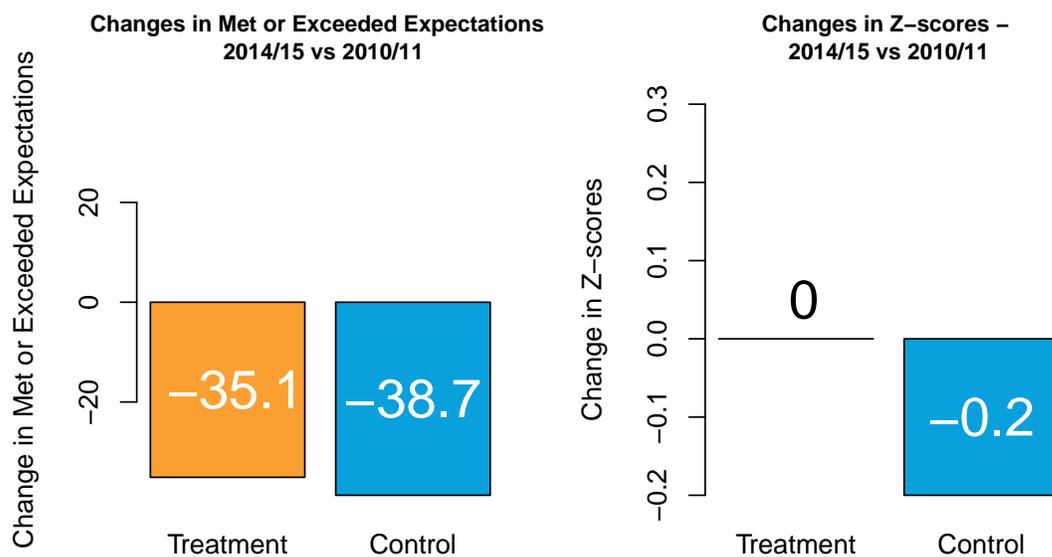


Figure 4: Changes in Met or Exceeded Expectations and accompanying z-scores (See Section 3.1) for Grade-Aggregated TRT and CTRL datasets between 2010/11 and 2014/15

Similarly, Figure 5 shows the changes in mean percentile ranking between TRT and CTRL.

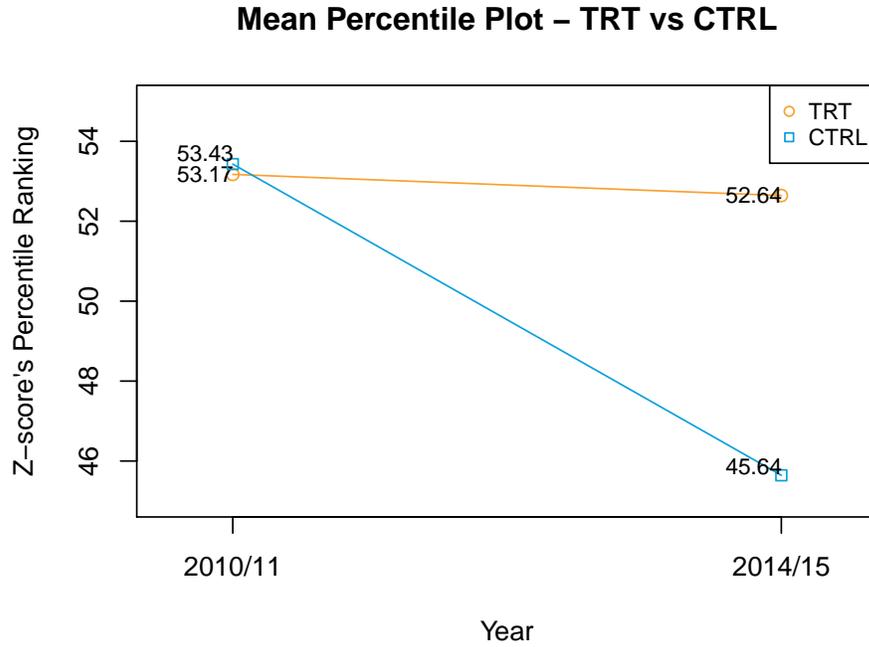


Figure 5: Changes in Percentile Ranking for TRT and CTRL Datasets between 2010/11 and 2014/15

Finally, table 8 shows the statistics for the *differences* in changes between TRT and CTRL (Treatment - Control) for these same PARCC math proficiency and z-score changes as in the above figures. ¹

	Estimate	P-Value	Int.Low	Int.High
Met or Exceeded Expectations	3.63	0.09	-0.54	7.80
Z-score	0.20	0.09	-0.03	0.43

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

¹* statistically significant p<0.05

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	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Prog.
TRT.10.11	25	25	1498	7.03	21.23	43.2	28.54	71.74	0.12	54.12	-
TRT.11.12	25	25	1446	5.1	19.82	41.93	33.15	75.08	0.24	57.52	73.54
TRT.12.13	25	25	1449	5.01	19.1	45.86	30.03	75.89	0.24	57.96	76.47
TRT.13.14	25	25	1443	6.03	18.57	43.16	32.23	75.39	0.25	58.32	75.08
TRT.14.15	25	25	1452	-	-	-	-	42.59	0.31	58.88	64.28
TRT.Delta	-	-	-	-	-	-	-	-29.15	0.19	4.76	-
CTRL.10.11	25	25	1722	6.39	20.44	42.51	30.66	73.17	0.20	57.04	-
CTRL.11.12	25	25	1735	6.05	18.41	39.9	35.64	75.54	0.27	59.92	-
CTRL.12.13	25	25	1669	6.75	18.13	40.24	34.88	75.12	0.20	56.88	-
CTRL.13.14	25	25	1623	6.16	16.25	41.57	36.01	77.58	0.38	62.72	-
CTRL.14.15	25	25	1640	-	-	-	-	36.19	-0.03	47.60	-
CTRL.Delta	-	-	-	-	-	-	-	-36.98	-0.24	-9.44	-

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

	# Grades	# Schools	# Students	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Prog.
TRT.10.11	20	20	1261	7.52	22.17	44.35	25.96	70.31	-0.00	49.35	-
TRT.11.12	20	20	1253	5.73	17.64	45.88	30.75	76.63	0.33	61.10	70.58
TRT.12.13	20	20	1183	5.64	18.09	46.1	30.18	76.28	0.31	60.55	74.03
TRT.13.14	20	20	1159	6.06	17.36	44.77	31.81	76.58	0.34	61.40	71.97
TRT.14.15	20	20	1141	-	-	-	-	30.42	-0.02	48.80	65.7
TRT.Delta	-	-	-	-	-	-	-	-39.89	-0.02	-0.55	-
CTRL.10.11	20	20	1351	6.78	22.11	45.11	25.99	71.11	0.05	50.75	-
CTRL.11.12	20	20	1415	6.86	21.74	41.33	30.08	71.41	0.03	50.75	-
CTRL.12.13	20	20	1470	7.21	20.6	43.71	28.48	72.19	0.07	51.90	-
CTRL.13.14	20	20	1397	8.43	21.7	42.8	27.07	69.87	-0.06	48.90	-
CTRL.14.15	20	20	1442	-	-	-	-	29.52	-0.07	46.50	-
CTRL.Delta	-	-	-	-	-	-	-	-41.59	-0.12	-4.25	-

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

	# Grades	# Schools	# Students	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Prog.
TRT.10.11	25	25	1482	7.2	24.57	38.32	29.91	68.23	0.18	55.28	-
TRT.11.12	25	25	1512	7.52	26.2	36.97	29.31	66.28	0.15	54.48	75.4
TRT.12.13	25	25	1504	6.58	24.67	42.03	26.72	68.75	0.25	58.92	85.24
TRT.13.14	25	25	1445	6.64	26.48	39.56	27.32	66.89	0.17	55.36	77.4
TRT.14.15	25	25	1365	-	-	-	-	31.00	0.01	49.48	65.82
TRT.Delta	-	-	-	-	-	-	-	-37.23	-0.17	-5.80	-
CTRL.10.11	25	25	1535	8.24	25.42	38.03	28.31	66.34	0.07	51.96	-
CTRL.11.12	25	25	1523	9.83	28	37.86	24.31	62.17	-0.07	49.04	-
CTRL.12.13	25	25	1598	10.1	26.2	36.54	27.16	63.70	-0.02	49.64	-
CTRL.13.14	25	25	1602	8.24	29.46	39.29	23.01	62.30	-0.07	48.56	-
CTRL.14.15	25	25	1556	-	-	-	-	28.14	-0.15	43.00	-
CTRL.Delta	-	-	-	-	-	-	-	-38.19	-0.22	-8.96	-

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

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

Figure 6 shows the difference in the growth of percentages of students at math Met or Exceeded Expectations, for the TRT and CTRL datasets, disaggregated by grade:

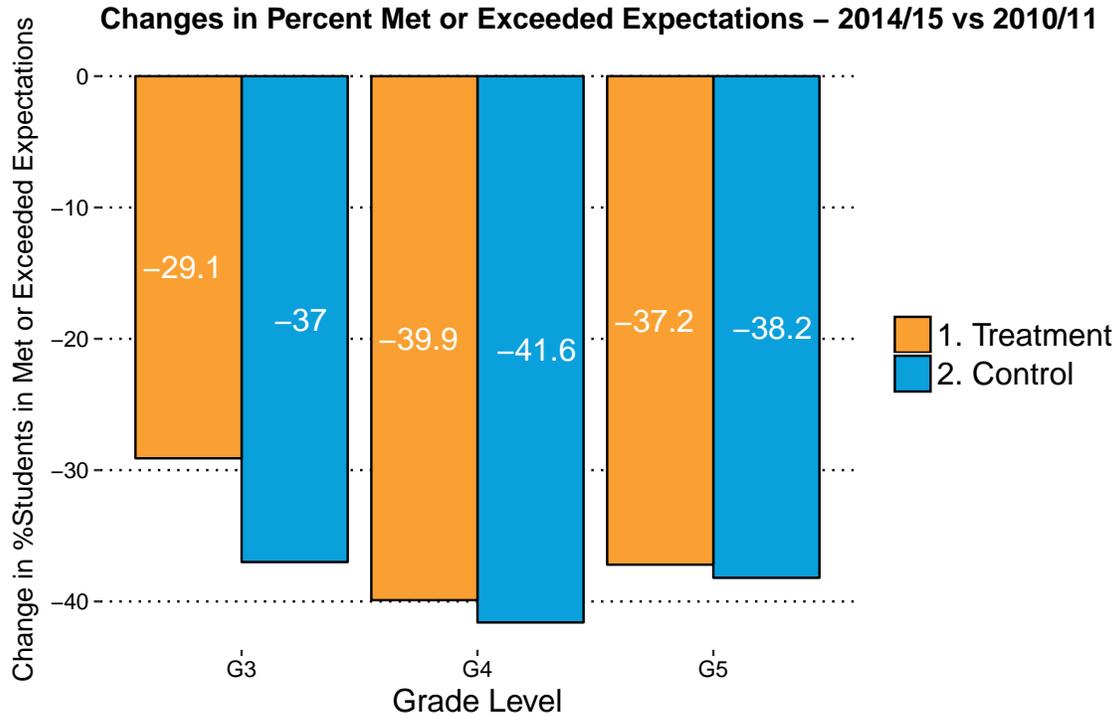


Figure 6: Changes in Percent of Students at Met or Exceeded Expectations for TRT and CTRL Datasets between 2010/11 and 2014/15

Table 12 shows the statistics for the *differences* in changes between TRT and CTRL (Treatment - Control) for these same Met or Exceeded Expectations math proficiency changes as shown in Figure 6.

	Estimate	P-Value	Int.Low	Int.High
Grade 3	7.84	0.02*	1.18	14.50
Grade 4	1.70	0.68	-6.60	10.00
Grade 5	0.96	0.78	-5.88	7.81

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

3.5.3 Grade-Level Analysis of Changes in Z-scores of Math Proficiency

Figure 7 shows the changes in the grade-mean z-scores of students for the TRT and CTRL datasets, disaggregated by grade:

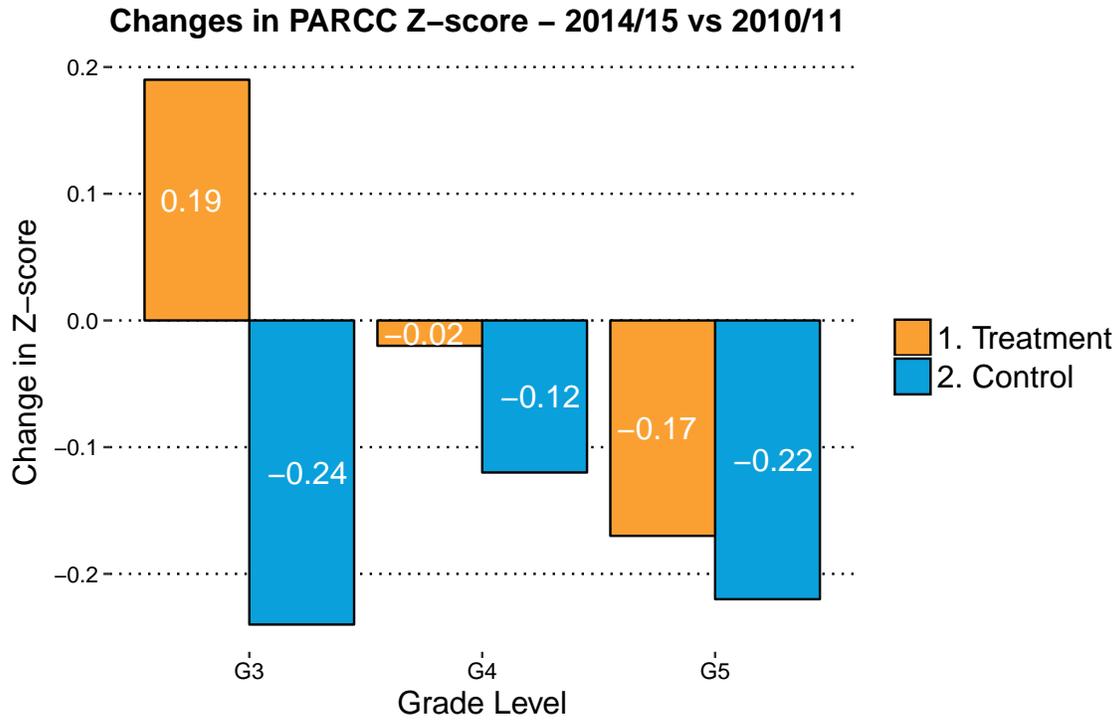


Figure 7: Changes in Grade-Mean PARCC Z-score (See Section 3.1) for TRT and CTRL Datasets between 2010/11 and 2014/15

Table 13 shows the statistics for the differences between TRT and CTRL (Treatment - Control) for these same z-score changes as shown in Figure 7.

	Estimate	P-Value	Int.Low	Int.High
Grade 3	0.42	0.02*	0.06	0.78
Grade 4	0.10	0.68	-0.38	0.58
Grade 5	0.06	0.77	-0.33	0.44

Table 13: Statistics for the Differential Changes in PARCC Z-scores (See Section 3.1) Growth, (TRT - CTRL)

4 Effect Size

The following table shows the effect sizes for Met or Exceeded Expectations and accompanying z-score.

	Z-score Effect Size	Met or Exceeded Expectations Effect Size
Grade 3	0.64	0.66
Grade 4	0.14	0.14
Grade 5	0.08	0.07
All Grades	0.28	0.28

Table 14: Cohen’s d Effect Size

5 Findings Summary

Colorado grades 3, 4, and 5 using ST Math for the year 2014/15 averaged 58.3% ST Math Progress. 70/97 grades (72%) averaged covering more than 50% of ST Math content. Statistically significant differences were found in this analysis for individual grade levels. Referring to Table 12, a statistically significant difference was found for grade 3 Met or Exceeded Expectations proficiency levels, with an estimate of 7.84 in favor of the ST Math treatment set. Similarly, looking at Table 13, grade 3 ST math treatment set outperformed their matched controls for PARCC z-scores with a statistically significant difference of 0.42.

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 15) and controls (Table 16) separately.

	# Grades	# Schools	# Students	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Comp.
Grade 3 (10.11)	25	25	1498	7.03	21.23	43.2	28.54	71.74	0.12	54.12	-
Grade 4 (10.11)	20	20	1261	7.52	22.17	44.35	25.96	70.31	0.00	49.35	-
Grade 5 (10.11)	25	25	1482	7.2	24.57	38.32	29.91	68.23	0.18	55.28	-
All Grades (10.11)	70	31	4241	7.23	22.69	41.79	28.29	70.08	0.11	53.17	-
Grade 3 (11.12)	25	25	1446	5.1	19.82	41.93	33.15	75.08	0.24	57.52	73.54
Grade 4 (11.12)	20	20	1253	5.73	17.64	45.88	30.75	76.63	0.33	61.10	70.58
Grade 5 (11.12)	25	25	1512	7.52	26.2	36.97	29.31	66.28	0.15	54.48	75.4
All Grades (11.12)	70	31	4211	6.14	21.48	41.29	31.09	72.38	0.23	57.46	73.36
Grade 3 (12.13)	25	25	1449	5.01	19.1	45.86	30.03	75.89	0.24	57.96	76.47
Grade 4 (12.13)	20	20	1183	5.64	18.09	46.1	30.18	76.28	0.31	60.55	74.03
Grade 5 (12.13)	25	25	1504	6.58	24.67	42.03	26.72	68.75	0.25	58.92	85.24
All Grades (12.13)	70	31	4136	5.75	20.8	44.56	28.89	73.45	0.26	59.04	78.9
Grade 3 (13.14)	25	25	1443	6.03	18.57	43.16	32.23	75.39	0.25	58.32	75.08
Grade 4 (13.14)	20	20	1159	6.06	17.36	44.77	31.81	76.58	0.34	61.40	71.97
Grade 5 (13.14)	25	25	1445	6.64	26.48	39.56	27.32	66.89	0.17	55.36	77.4
All Grades (13.14)	70	31	4047	6.26	21.05	42.34	30.36	72.69	0.25	58.14	75.02
Grade 3 (14.15)	25	25	1452	-	-	-	-	42.59	0.31	58.88	64.28
Grade 4 (14.15)	20	20	1141	-	-	-	-	30.42	-0.02	48.80	65.7
Grade 5 (14.15)	25	25	1365	-	-	-	-	31.00	0.01	49.48	65.82
All Grades (14.15)	70	31	3958	-	-	-	-	34.98	0.11	52.64	65.24

Table 15: TRT Grades Detail Sorted by Year

	# Grades	# Schools	# Students	L1	L2	L3	L4	Met or Exceeded Expectations	Z-Score	Percentile	ST Math Per Comp.
Grade 3 (10.11)	25	25	1722	6.39	20.44	42.51	30.66	73.17	0.20	57.04	-
Grade 4 (10.11)	20	20	1351	6.78	22.11	45.11	25.99	71.11	0.05	50.75	-
Grade 5 (10.11)	25	25	1535	8.24	25.42	38.03	28.31	66.34	0.07	51.96	-
All Grades (10.11)	70	65	4608	7.16	22.7	41.65	28.49	70.14	0.11	53.43	-
Grade 3 (11.12)	25	25	1735	6.05	18.41	39.9	35.64	75.54	0.27	59.92	-
Grade 4 (11.12)	20	20	1415	6.86	21.74	41.33	30.08	71.41	0.03	50.75	-
Grade 5 (11.12)	25	25	1523	9.83	28	37.86	24.31	62.17	-0.07	49.04	-
All Grades (11.12)	70	65	4673	7.63	22.79	39.58	30	69.58	0.08	53.41	-
Grade 3 (12.13)	25	25	1669	6.75	18.13	40.24	34.88	75.12	0.20	56.88	-
Grade 4 (12.13)	20	20	1470	7.21	20.6	43.71	28.48	72.19	0.07	51.90	-
Grade 5 (12.13)	25	25	1598	10.1	26.2	36.54	27.16	63.70	-0.02	49.64	-
All Grades (12.13)	70	65	4737	8.08	21.72	39.91	30.29	70.20	0.08	52.87	-
Grade 3 (13.14)	25	25	1623	6.16	16.25	41.57	36.01	77.58	0.38	62.72	-
Grade 4 (13.14)	20	20	1397	8.43	21.7	42.8	27.07	69.87	-0.06	48.90	-
Grade 5 (13.14)	25	25	1602	8.24	29.46	39.29	23.01	62.30	-0.07	48.56	-
All Grades (13.14)	70	65	4622	7.55	22.53	41.11	28.81	69.92	0.09	53.71	-
Grade 3 (14.15)	25	25	1640	-	-	-	-	36.19	-0.03	47.60	-
Grade 4 (14.15)	20	20	1442	-	-	-	-	29.52	-0.07	46.50	-
Grade 5 (14.15)	25	25	1556	-	-	-	-	28.14	-0.15	43.00	-
All Grades (14.15)	70	65	4638	-	-	-	-	31.41	-0.09	45.64	-

Table 16: CTRL Grades Detail Sorted by Year

8 Lists of Schools

8.1 Treatment Schools

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

PID	IID	District	School Name	GRADE
149034	AUD68Q	COLORADO SPRINGS 11	AUDUBON ELEMENTARY SCHOOL	3, 4, 5
149058	BRI68Q	COLORADO SPRINGS 11	BRISTOL ELEMENTARY SCHOOL	3
149060	BUE68Q	COLORADO SPRINGS 11	BUENA VISTA ELEMENTARY SCHOOL	3, 4, 5
3012131	CHI68R	COLORADO SPRINGS 11	CHIPETA ELEMENTARY SCHOOL	3, 5
149084	COL68R	COLORADO SPRINGS 11	COLUMBIA ELEMENTARY SCHOOL	4, 5
149125	EDI68Q	COLORADO SPRINGS 11	EDISON ELEMENTARY SCHOOL	3, 5
10910980	FRE68S	COLORADO SPRINGS 11	FREEDOM ELEMENTARY SCHOOL	3, 4, 5
149163	FRE68R	COLORADO SPRINGS 11	FREMONT ELEMENTARY SCHOOL	3, 4, 5
149187	GRA68R	COLORADO SPRINGS 11	GRANT ELEMENTARY SCHOOL	3
149204	HEN68R	COLORADO SPRINGS 11	HENRY ELEMENTARY SCHOOL	3, 4, 5
149230	HOW68Q	COLORADO SPRINGS 11	HOWBERT ELEMENTARY SCHOOL	3, 5
149254	JAC68Q	COLORADO SPRINGS 11	JACKSON ELEMENTARY SCHOOL	3
149278	KEL68R	COLORADO SPRINGS 11	KELLER ELEMENTARY SCHOOL	3, 5
2226743	KIN68R	COLORADO SPRINGS 11	KING ELEMENTARY SCHOOL	3, 4, 5
149319	MAD68Q	COLORADO SPRINGS 11	MADISON ELEMENTARY SCHOOL	3, 4, 5
3055602	MAR68R	COLORADO SPRINGS 11	MARTINEZ ELEMENTARY SCHOOL	4, 5
10910978	MCA68R	COLORADO SPRINGS 11	MCAULIFFE ELEMENTARY	3, 4, 5
149333	MID68Q	COLORADO SPRINGS 11	MIDLAND ELEMENTARY SCHOOL	3, 4, 5
149357	MON68R	COLORADO SPRINGS 11	MONROE ELEMENTARY SCHOOL	4
149383	PEN68R	COLORADO SPRINGS 11	PENROSE ELEMENTARY SCHOOL	5
149400	QUE68Q	COLORADO SPRINGS 11	QUEEN PALMER ELEMENTARY SCHOOL	3
149527	ROG68R	COLORADO SPRINGS 11	ROGERS ELEMENTARY SCHOOL	5
2179528	RUD68R	COLORADO SPRINGS 11	RUDY ELEMENTARY SCHOOL	3, 4, 5
4810297	SCO68R	COLORADO SPRINGS 11	SCOTT ELEMENTARY SCHOOL	3, 4, 5
149448	STE68Q	COLORADO SPRINGS 11	STEELE ELEMENTARY SCHOOL	3, 4, 5
149450	STR68Q	COLORADO SPRINGS 11	STRATTON ELEMENTARY SCHOOL	3, 4, 5
149462	TAY68Q	COLORADO SPRINGS 11	TAYLOR ELEMENTARY SCHOOL	3, 4, 5
4810302	TRA68R	COLORADO SPRINGS 11	TRAILBLAZER ELEMENTARY SCHOOL	3, 4, 5
149321	TWA68Q	COLORADO SPRINGS 11	TWAIN ELEMENTARY SCHOOL	3, 4, 5
11521893	WES68Q	COLORADO SPRINGS 11	WEST ELEMENTARY SCHOOL	3, 4
149539	WIL68R	COLORADO SPRINGS 11	WILSON ELEMENTARY SCHOOL	5

Table 17: 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
4806181	ACADEMY 20	ACADEMY ENDEAVOUR ELEMENTARY SCHOOL	5
2897366	ADAMS 12 FIVE STAR SCHOOLS	HUNTERS GLEN ELEMENTARY SCHOOL	3
3006156	ADAMS 12 FIVE STAR SCHOOLS	RIVERDALE ELEMENTARY SCHOOL	3
152794	BAYFIELD 10 JT-R	BAYFIELD ELEMENTARY SCHOOL	3
150277	CANON CITY RE-1	HARRISON SCHOOL	3
150289	CANON CITY RE-1	LINCOLN SCHOOL OF SCIENCE AND TECHNOLOGY	5
157275	CENTER 26 JT	HASKIN ELEMENTARY SCHOOL	5
143987	CHERRY CREEK 5	HOLLY HILLS ELEMENTARY SCHOOL	3
1526760	CHERRY CREEK 5	INDEPENDENCE ELEMENTARY SCHOOL	4
11557531	CHERRY CREEK 5	PINE RIDGE ELEMENTARY SCHOOL	5
1541916	CHERRY CREEK 5	SAGEBRUSH ELEMENTARY SCHOOL	4
2895100	CHERRY CREEK 5	TIMBERLINE ELEMENTARY SCHOOL	4
4753027	CHEYENNE MOUNTAIN 12	GOLD CAMP ELEMENTARY SCHOOL	3
146513	DENVER COUNTY 1	COLLEGE VIEW ELEMENTARY SCHOOL	5
4949939	DENVER COUNTY 1	GRANT RANCH ECE-8 SCHOOL	4
147115	DENVER COUNTY 1	PALMER ELEMENTARY SCHOOL	3
11129081	DOUGLAS COUNTY RE 1	CLEAR SKY ELEMENTARY	4
4366624	DOUGLAS COUNTY RE 1	COYOTE CREEK ELEMENTARY SCHOOL	3
10024983	DOUGLAS COUNTY RE 1	NORTH STAR ACADEMY	3
152847	DURANGO 9-R	FLORIDA MESA ELEMENTARY SCHOOL	5
4448325	EAGLE COUNTY RE 50	AVON ELEMENTARY SCHOOL	5
148602	EAGLE COUNTY RE 50	EAGLE VALLEY ELEMENTARY SCHOOL	5
3394226	EAGLE COUNTY RE 50	GYPSUM ELEMENTARY SCHOOL	5
155435	EAST OTERO R-1	LA JUNTA INTERMEDIATE SCHOOL	5, 4
157964	EATON RE-2	GALETON ELEMENTARY SCHOOL	4
144175	ENGLEWOOD 1	CHARLES HAY WORLD SCHOOL	4
5090335	FALCON 49	SPRINGS RANCH ELEMENTARY SCHOOL	4
155289	FORT MORGAN RE-3	GREEN ACRES ELEMENTARY SCHOOL	4
11554565	FOUNTAIN 8	WEIKEL ELEMENTARY SCHOOL	4
155526	FOWLER R-4J	FOWLER ELEMENTARY SCHOOL	5
150382	FREMONT RE-2	PENROSE ELEMENTARY SCHOOL	5
150459	GARFIELD RE-2	CACTUS VALLEY ELEMENTARY SCHOOL	3
1484710	GREELEY 6	SHAWSHEEN ELEMENTARY SCHOOL	3
149802	HARRISON 2	MONTEREY ELEMENTARY SCHOOL	4
151788	JEFFERSON COUNTY R-1	ALLENDALE ELEMENTARY SCHOOL	4
4751031	JEFFERSON COUNTY R-1	BERGEN VALLEY INTERMEDIATE SCHOOL	5
151386	JEFFERSON COUNTY R-1	DEANE ELEMENTARY SCHOOL	3
151324	JEFFERSON COUNTY R-1	LASLEY ELEMENTARY SCHOOL	5
151568	JEFFERSON COUNTY R-1	RED ROCKS ELEMENTARY SCHOOL	5
151130	JEFFERSON COUNTY R-1	THOMSON ELEMENTARY SCHOOL	5
144278	LITTLETON 6	CENTENNIAL ACADEMY OF FINE ARTS EDUCATION	5
152055	LITTLETON 6	MOODY ELEMENTARY SCHOOL	3
154467	MESA COUNTY VALLEY 51	ORCHARD AVENUE ELEMENTARY SCHOOL	4
155057	MONTROSE COUNTY RE-1J	OAK GROVE ELEMENTARY SCHOOL	5
153035	POUDRE R-1	BAUDER ELEMENTARY SCHOOL	3
153047	POUDRE R-1	BEATTIE ELEMENTARY SCHOOL	5
153176	POUDRE R-1	IRISH ELEMENTARY SCHOOL	3
4320876	POUDRE R-1	MCGRAW ELEMENTARY SCHOOL	3
153322	POUDRE R-1	TAVELLI ELEMENTARY SCHOOL	4
153334	POUDRE R-1	TIMNATH ELEMENTARY SCHOOL	3
156128	PUEBLO CITY 60	BEULAH HEIGHTS ELEMENTARY SCHOOL	4
156269	PUEBLO CITY 60	HAAFF ELEMENTARY SCHOOL	3, 4
156441	PUEBLO CITY 60	SOUTH PARK ELEMENTARY SCHOOL	3
156465	PUEBLO CITY 60	SUNSET PARK ELEMENTARY SCHOOL	5
156582	PUEBLO COUNTY 70	NORTH MESA ELEMENTARY SCHOOL	3

Table 18: Matched Control Schools (CTRL Dataset)

PID	District	School Name	GRADE
156635	PUEBLO COUNTY 70	RYE ELEMENTARY SCHOOL	5
156661	PUEBLO COUNTY 70	SOUTH MESA ELEMENTARY SCHOOL	5
4478605	ROARING FORK RE-1	SOPRIS ELEMENTARY SCHOOL	3
5091353	SCHOOL DISTRICT 27J	JOHN W THIMMIG ELEMENTARY SCHOOL	5
2057231	SUMMIT RE-1	DILLON VALLEY ELEMENTARY SCHOOL	4, 3
153384	THOMPSON R2-J	B F KITCHEN ELEMENTARY SCHOOL	3
153401	THOMPSON R2-J	BERTHOUD ELEMENTARY SCHOOL	3, 4
153499	THOMPSON R2-J	NAMAQUA ELEMENTARY SCHOOL	5
1825102	THOMPSON R2-J	SARAH MILNER ELEMENTARY SCHOOL	4, 5
150045	WIDEFIELD 3	PINELLO ELEMENTARY SCHOOL	3

Table 19: Matched Control Schools (CTRL Dataset)