Evaluating Student Performance Amidst the Covid-19 Pandemic using Propensity Score Matching

(In Coordinated Session: Impact of the Pandemic from Multiple Analytic Perspectives)

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Abstract

The purpose of the current research study was to investigate the extent to which student performance was influenced by the disruption to learning that occurred due to the Covid-19 pandemic. To explain observed differences in performance, we compared outcomes from a state-wide summative testing program between students who were administered the test in 2019 and 2021. Because the background and demographic characteristics of the two testing populations differed on several variables, including race/ethnicity, locale, and subgroup membership, propensity score matching was used to develop comparable groups for analyses. Independent samples t-tests were then conducted to assess whether there were significant differences in mean scaled scores and domain subscores between the two matched groups. In addition, the same procedures were used to develop and analyze differences for specific student subgroups (students with disabilities, economically disadvantaged students, and English language learners). Overall, results indicated that the 2021 test-takers earned lower scores than students who tested in 2019 for all subjects and grade levels, except English Language Arts (ELA) grade 8. Moreover, larger score differences were observed for mathematics than ELA. Lastly, results from subgroup analyses indicated that in mathematics all subgroups earned significantly lower scores in 2021 than 2019, whereas in ELA grades 5 through 7, English Language Learners and economically disadvantaged subgroups earned lower scores in 2021 than 2019. The results of this study suggest that after controlling for differences between the 2021 and 2019 populations, student performance was likely influenced by the disruption to learning due to pandemic-related factors.

Introduction

The Covid-19 pandemic has undoubtedly introduced hurdles in educational systems and consequentially educational measurement over the past two school years. Across the country, states, districts, and schools employed a variety of instructional models (in-person, remote, and hybrid models) to limit exposure for their students, faculty, and staff. Yet, protocols differed across states and within states, depending on each state's governmental response to the pandemic. Factors that contribute to an increased risk of contracting the virus (i.e., occupation and housing) may have also influenced local policies that informed school closures over the duration of the pandemic (Center for Disease Control [CDC], 2020). As such, Covid-19 has not only impacted the population at-large, but also impacted minority groups and vulnerable populations disproportionately.

The educational measurement community continues to grapple with what to measure and how to measure the impact of the pandemic on student learning. Unfinished learning, disruption to learning, and learning loss are several terms that have been used to describe this expected impact of the pandemic on student learning. Results from interim assessments were emphasized to provide preliminary information and evidence of unfinished learning (Curriculum Associates, 2021; Kuhfeld, Tarasawa, Johnson, Ruzek, & Lewis, 2020; Renaissance, 2021). Researchers found that in 2020, students in grades 3 through 8 performed similarly on the NWEA MAP interim assessment to fall 2019 in reading but performed lower in math (Kuhfeld et al., 2020). Additional research conducted in the beginning of the 2021-2022 school year reinforced these findings, indicating that the percent of students who performed on-grade level in upper elementary and lower middle school grades was similar in 2021 to prior (pre-pandemic) levels in reading; however, the percent of students performing on-grade level was lower in 2021 than prior levels in mathematics (Curriculum Associates, 2021). Other research findings added to the growing body of literature, indicating that student growth percentiles were lower for mathematics than ELA and that student performance continues to fall farther behind expectations. Moreover, they investigated differences in subgroup performance and identified several subgroups of students (i.e., Black and Hispanic students, students with disabilities, English language learners, and students from urban settings) that performed substantially lower than expectations (Renaissance, 2021). These findings support patterns across results from various interim assessments and although meaningful information can be gleaned from the aggregation of these studies in 2020 and 2021, the administration conditions of interim assessments may have varied throughout the pandemic. For example, testing procedures may have allowed students to test at home, possibly with parental involvement as opposed to teacher supervision. Therefore, similar research is warranted on standardized summative assessments that are administered under the same conditions as previous years.

After the widespread cancellation of state-wide summative tests in Spring 2020, the results from the Spring 2021 state-wide summative tests were emphasized to continue adding to the body of literature around how students have been impacted by the disruption to learning. However, lower participation rates and non-representativeness across student background and demographic characteristics were observed in spring 2021 in many states. As such, directly comparing the 2021 cohort to any previous cohorts was inappropriate because the 2021 cohort was not representative of the historically consistent testing population. Due to these issues with representation, statistical methods were employed to properly analyze and interpret differences in student performance between the 2021 and prior cohorts.

The purpose of the current research study was to investigate the extent to which student performance was influenced by the disruption to learning that occurred due to the Covid-19 pandemic.

Using summative assessment data from one state, this study addressed the following research questions:

1. How does student performance in 2021 compare to 2019?
2. What specific domains of knowledge have been most impacted by the disruption to student learning in 2021?
3. Which subgroups of students show significant differences in student performance between 2021 and 2019?

Methods

Data

To address the research questions, state-wide summative data from 2021 and 2019 was aggregated for English Language Arts (ELA) and mathematics grades 5 through 8. Only students enrolled in public schools were included in the analysis sets. State-wide summative data included demographic characteristics (race/ethnicity, gender), as well as subgroup membership (English Language Learners (ELLs), students with disabilities, and economically disadvantaged students). Additional variables included whether the student used an accommodation or a designated support on their examination (i.e., multiplication tables for mathematics, or the use of text-to-speech functionality or whether the examination was administered in a separate setting). Table 1 summarizes the student-level characteristics considered in this study.

Then, data was merged with test performance on ELA and math from 2 years prior (i.e., performance on ELA grade 5 in 2021 was merged with ELA grade 3 and math grade 3 test performance in 2019; see Table 2). The 2019 cohort was matched with prior performance from 2017 and the 2021 cohort was matched with prior performance from 2019. Student records with no prior performance or partial performance we excluded from the analysis sets. Once each dataset included key demographic variables and prior test performance, district-level data from National Center for Educational Statistics (NCES) was merged to include locale type (NCES, 2020).

Analyses

Once datasets were established, propensity score matching (PSM) was used to develop two comparable groups of test-takers (Rosenbaum & Rubin, 1983). Propensity scores were calculated using a multinomial logistic model (see equation 1). To ensure that students at each propensity score level had equal probability of being in either condition groups, common support techniques were employed. Specifically, after propensity scores were calculated, descriptive statistics for each condition were computed and the dataset was refined to only include students with propensity scores greater than the maximum of the minimum of propensity scores (by condition group) and the minimum of the maximum of propensity scores by condition group.

$$Pr(y) = \frac{1}{1+e^{-(B_1x_1+B_2x_2+\ldots+B_nx_n+B_0)}} \qquad \text{(Equation 1)}$$

Once common support was established, propensity scores were matched (1:1) without replacement to create matched samples. The matched control group refers to the cohort of 2019 test-takers and the

matched treatment group refers to the cohort of 2021 test-takers. The match quality was assessed for the covariates using mean differences, as well as chi-square tests for categorical variables and t-tests for continuous variables to identify covariates that were significantly different between the matched samples. The Bonferroni correction for family-wise error was applied when appropriate. In addition, Cohen's D was calculated as a measure of standardized differences. Using previously established criteria, the absolute value of Cohen's D effect size for each covariate should be less than 0.10 and the average effect size should be less than 0.05. Lastly, we calculated and compared McFadden's pseudo-R^2 for the unmatched datasets and the matched datasets (McFadden, 1974) and results were evaluated by comparing the pseudo-R^2 value from the logistic regression model on the unmatched data and the matched data (Staffa & Zurakowski, 2018). The matched pseudo-R^2 should be lower than that of the unmatched data and close to 0, meaning after matching the covariates do not predict well whether or not the student was in the control group or treatment group.

Then, independent samples t-tests were conducted, and effect sizes were calculated to assess whether there were significant differences in scores. Scaled scores were analyzed to examine overall differences in student performance (research question 1) and raw scores were analyzed with respect to student performance for each domain of knowledge (research question 2). Domain raw scores represent scores on the common items administered across years, and therefore can be compared directly. Note that the 2021 mathematics operational test forms were reused from the spring 2019 administration, therefore all items were common for the 2019 and 2021 administrations. ELA test forms were reused with a minor modification from spring 2019 resulting in about 90% of the ELA test items being common between the two administrations. Effect sizes were classified using commonly used conventions where values of 0.01 were considered very small, values of 0.2 were considered small, values of 0.5 were considered moderate, and values of 0.8 were considered large, values greater than 1.2 were considered very large and values greater than 2.0 were considered huge (Sawilowsky, 2009).

To address research question 3, data was disaggregated for each of the following subgroups for each subject and grade level: students with disabilities, economically disadvantaged students (also referred to as low socio-economic status [SES]), and English Language Learners (ELLs). For each subgroup, subject and grade level, the PSM methods discussed above were applied to achieve comparable matched samples. Then, t-tests were conducted, and effect sizes were calculated to assess whether there were significant differences in overall scaled scores.

SAS was used for data aggregation and management. Analyses were conducted in R, and PSM analyses were conducted using MatchIt within R (Ho, Imai, King & Stuart, 2011).

Results

Table 3 displays the sample sizes before (unmatched) and after (matched) PSM by subject and grade level. The control group refers to the 2019 cohort of test-takers and the treatment group refers to the 2021 cohort of test-takers. The sample sizes between the control and treatment groups differed by approximately 6,000 to 10,000 students per grade level. The participation rate for the state-wide summative test ranged from 83% to 89%, which may indicate some stability in the representativeness of the 2021 cohort of test-takers.

After computing propensity scores and ensuring common support, match quality was assessed (see Table 4). The means of dichotomous variables represent proportions, and the means of continuous

variables represent the average within the dataset. For dichotomous variables, two-proportion Z-tests were conducted to assess whether the proportions between the control and treatment groups were significantly different. For continuous variables, independent sample t-tests were used to test whether the means between the two groups were significantly different. Then, mean differences and effect sizes (Cohen's D) were calculated to assess match quality (see Table 4). Table 11 in the Appendix shows demographic representation for each covariate for the unmatched data.

For most subjects and grade levels, there were very few covariates with significant differences, indicating that PSM functioned well at developing two matched samples for each subject and grade level. However, for ELA grade 7 and math grade 7, there were many more covariates with significant differences not observed for other grade levels. Because this finding occurs for both subjects in grade 7, this may suggest that other variables not included in the model may contribute to the population of students testing in grade 7. Although there were covariates for each subject and grade level that indicated significant differences between the control and treatment groups, all effect sizes were low and met the criterion threshold of less than 0.10. In fact, most effect sizes were less than 0.05. The maximum and average effect sizes are shown in Table 5.

To evaluate the matched sample, average effect sizes and McFadden's pseudo-R^2 were calculated (see Table 5). For all subjects and grade levels, the absolute value of Cohen's D effect size for each covariate were less than 0.10 and the average effect size was less than 0.05, meeting both pre-established criteria (see Tables 4 and 5). Table 5 reports McFadden's pseudo-R^2, indicating that the matched pseudo-R^2 is very close to 0, however the initial values for the unmatched population tended to be low as well. On the other hand, the other match quality evidence presented in Tables 4 and 5 supports match quality by the small mean differences and effect sizes that met acceptable criteria.

Research Question 1

To examine differences in scaled scores between the 2019 and 2021 matched samples, independent t-tests were conducted, and Cohen's D effect sizes were calculated (see Table 6). The results indicated that students in 2021 performed significantly lower than students in 2019 for all subjects except ELA grade 8. Larger mean differences in scores were observed for mathematics (minimum = 6.133, maximum = 13.047) than ELA (minimum = 0.944, maximum = 5.291). The effect sizes ranged from 0.018 (very small) to 0.223 (small). The largest differences occurred for ELA grade 6, $t(97900) = 17.093,\ p < .001$ and math grade 6, $t(97818) = 36.482, p < .001$.

Research Question 2

Upon analyzing domain scores for each subject and grade level, results showed that students in 2021 performed significantly lower than their counterparts in 2019 for all mathematics domains (see Table 7). The effect sizes for math subscore differences ranged from 0.037 to 0.226, indicating very small to small effects. Consistent with findings from research question 1, student performance in math grade 6 had the largest mean differences and largest effect sizes across the Number System, Equations and Expressions and Statistics and Probability domains.

For ELA, the results were somewhat mixed. Students in 2021 performed significantly lower than their counterparts in 2019 in the writing/language subdomain, however differences in domain scores in listening and reading varied by grade level. Specifically, in listening and reading domains, the 2021 group of fifth and sixth grade test-takers performed significantly lower than their counterparts in 2019, but the

2021 group of eighth grade test-takers performed significantly higher than their counterparts in 2019. Moreover, mean differences for the reading domain in grade 7 and grade 8 were positive, indicating the 2021 group of students performed slightly better than the 2019 group of students. However, effect sizes tended to be weaker for ELA than mathematics, ranging from 0.018 to 0.096.

Research Question 3

To better understand if and how subgroups of students were impacted differentially by the disruption to learning, analyses were conducted for three subgroups of students: students with disabilities, ELLs, and economically disadvantaged students (referred to as Low SES). Table 8 shows the count of students for each subgroup for the total population (unmatched) and matched samples. The participation rate for the students with disabilities subgroup was the highest across all subjects and grade levels, ranging from 82% to 89%, which may indicate some stability in the representativeness of this subgroup. Conversely, there was much more variability in the ELL subgroup with participation rates ranging from 66% for lower grade levels to 94% for grade 8. This level of variability supports the need for PSM to establish comparable, matched samples if one wants to draw conclusions about differences in student performance.

To evaluate the matched samples, average effect sizes and McFadden's pseudo-R^2 were calculated (see Table 9). The maximum absolute value of Cohen's D effect size across all covariates was less than 0.10 for all subjects and grade levels except for the ELL subgroup for ELA grades 7 and 8 and math grades 7 and 8. In each case, there was a significantly lower representation of economically disadvantaged students in the matched treatment group than the matched control group. Yet, the average effect sizes were all less than 0.05. Table 9 also reports McFadden's pseudo-R^2 for the model based on the unmatched data and matched data for each subject, grade, and subgroup. Similar to overall results, the matched pseudo-R^2 values were very close to 0, however the initial values for the total, unmatched population tended to be low as well. In addition, the covariate means and the mean differences (see Table 12 in Appendix), provide additional evidence that supports match quality through the small mean differences and effect sizes that met acceptable criteria for the matched samples.

Table 10 presents the results from independent samples t-tests for subgroups within each subject and grade level. The Bonferroni correction for family-wise error was applied. The findings indicated that for ELA grades 5 through 7, there were significant differences in overall performance for ELL and economically disadvantaged subgroups ($p < .001$), in which the 2021 matched sample performed lower than the 2019 matched sample. Effect sizes ranged from 0.028 (very small) to 0.276 (small). There were small, non-significant differences for the disability subgroup in ELA grades 5 through 7. For all mathematics grades and subgroups, the 2021 matched samples performed significantly lower than the 2019 matched samples, with very small (0.056) to small (0.383) effect sizes. Although all subgroups earned significantly lower scores in mathematics, English Language Learners and economically disadvantaged students tended to have larger mean score differences and higher effect sizes than students with disabilities.

Discussion

Using summative assessment data from one state, the results of this study provide evidence of differences in student performance between the 2021 and 2019 testing populations, likely influenced by the disruption to learning during the Covid-19 pandemic. In the educational measurement community, we acknowledge that student knowledge and skills was likely impacted by the disruption during the

spring semester of the 2019-2020 school year and the non-streamlined approach to instructional modes throughout the 2020-2021 school year. The evidence presented in this paper shows that the groups of 2019 and 2021 test-takers were both qualitatively and quantitatively different (see Table 11 in the Appendix). Prior to matching, there was a higher proportion of white students and lower proportion of black and Hispanic students testing in 2021 compared to 2019. In addition, there was a lower proportion of students testing from urban or city settings. The 2021 cohort earned higher scores on prior mathematics tests and lower scores on prior ELA tests in comparison to the 2019 cohort across all subjects and grade levels. Therefore, PSM was necessary in order to draw conclusions about differences in student performance across populations.

After attempting to control for these differences by developing comparable groups using PSM, the 2021 group of test-takers earned lower scaled scores compared to the 2019 group of test-takers across all subjects and grades, except ELA grade 8. In addition, the differences in magnitude between ELA and mathematics suggests that math knowledge and skills were impacted more than ELA knowledge and skills, as measured by the state-wide summative test. Similar findings were observed for interim assessments across several states (Curriculum Associates, 2021; Kuhfeld et al., 2020; Renaissance, 2021). Results from domain score analyses indicated that the 2021 group of test-takers performed significantly lower than their counterparts in 2019 for all mathematics domains ($p < .001$), whereas results were somewhat mixed for ELA subdomains. While the 2021 group of students performed significantly lower than their counterparts in 2019 in the writing/language subdomain, domain scores in listening and reading varied by grade level. These findings suggest that the disruption to education from the pandemic may have influenced (among other factors) domain-specific learning and instruction. Further research in this area is warranted.

Results from analyzing student performance by subgroup membership showed the largest differences in scaled scores and effect sizes for the ELL subgroup. Significantly lower performance was also observed for economically disadvantaged students for ELA grades 5 through 7 and all math grade levels. The 2021 group of students with disabilities tended to have lower scaled scores than the matched 2019 group for mathematics, but not ELA. Lastly, students with disabilities, ELLs, and economically disadvantaged students showed larger differences between 2021 and 2019 than differences in the total population. These findings have implications for the future as it will be important to address and monitor these differences for subgroups of interest in order to bridge the gap caused by the disruption to student learning. Additional research can also be conducted to evaluate year-to-year performance of other demographic groups.

Lastly, there are several assumptions of PSM analyses. PSM requires that all the variables that affect assignment to the treatment group are measured. In addition, because PSM is an application of regression analysis, one must also assume that the treated observation data reflects the population and data is missing at random. First, we acknowledge that not all variables that may impact assignment to the treatment group were included in the model. Factors such as community-level outbreak rate and local policy decisions for specific learning modalities along with student-level factors such as recent or continued exposure undoubtedly impact whether a student is included in the 2021 test-taking population. Moreover, there was not sufficient information to identify and match students to specific instructional model as these have also changed over the course of the 2020-21 school year. Students in city settings may have had less opportunity for in-person instructional models because students in large urban areas tended to be impacted more heavily by Covid-19 outbreaks than students in small, rural

communities. Instead, the covariates used in this study attempt to address the representation of student background and demographic characteristics. Furthermore, these factors also impact whether the data is missing at random. Neither students, districts, nor schools were randomly assigned to different instructional models during the 2020-2021 school year, therefore the treated population data was not missing at random.

While these two considerations limit the generalizability of the conclusions of this study, it is important to note that the purpose of this study was not to generalize conclusions to all publicly educated students in the United States, rather to help contextualize student performance results in 2021. The information presented in this study can help support the ongoing teaching and learning of students amidst the pandemic; the key purpose of this paper is to help explain the impact of the disruption to student leaning caused by the pandemic to best support students in the future.

Table 1. Student-Level Characteristics/Covariates.

Category	Covariate	Values	Description
Race/Ethnicity	Asian	0/1	Mutually exclusive ethnicities included in analysis are Asian or Pacific Islander (not Hispanic), Black/African American (not Hispanic), Hispanic, White/Caucasian (not Hispanic) and multi-race. Other race/ethnicity was used as the reference group.
	Black	0/1	
	Hispanic	0/1	
	Multi-race	0/1	
	White	0/1	
Gender	Male	0/1	Genders included Male and Female. Female was used as the reference group.
District Locale	City	0/1	NCES (2020) defines the district classifications as four mutually exclusive categories of school location: city, suburb, town, and rural. Schools are assigned to these categories in the NCES Common Core of Data based the proximity to an urbanized area. Other/unknown locale was used as the reference group.
	Rural	0/1	
	Suburb	0/1	
	Town	0/1	
Subgroup	Disability	0/1	Identifies students who have a disability.
	English Language Learner (ELL)	0/1	Identifies students as English Language Learners for the current administration.
	Low Socio-Economic Status (SES)	0/1	Identifies students who meet requirements based on household income.
Accommodations/ Designated Supports	Multiplication Table	0/1	Identifies whether a student received an accommodation for multiplication table during exam administration (Math only). An interaction term between this accommodation and disability was included in the model.
	Separate Setting	0/1	Identifies whether a student received a designated support for separate setting during exam administration. An interaction term between separate setting and disability was included in the model.
	Text-to-speech	0/1	Identifies whether a student received a designated support for text-to-speech during exam administration. An interaction term between text-to-speech and disability was included in the model.
Prior Performance	ELA Scaled Score	330-950	Student's earned ELA score from 2 years prior. Scaled scores are vertically scaled across grade levels. Linear and quadratic terms were included in the model.
	Math Scaled Score	360-870	Student's earned Math score from 2 years prior. Scaled scores are vertically scaled across grade levels. Linear and quadratic terms were included in the model.

Table 2. Matched Grade Levels by Subject.

Subject/ Grade	Matched Subjects	Matched Grade
ELA Grade 5	ELA and Math	3
ELA Grade 6	ELA and Math	4
ELA Grade 7	ELA and Math	5
ELA Grade 8	ELA and Math	6
Math Grade 5	ELA and Math	3
Math Grade 6	ELA and Math	4
Math Grade 7	ELA and Math	5
Math Grade 8	ELA and Math	6

Table 3. Sample Sizes for Unmatched and Matched Samples by Subject and Grade.

Subject/	Unmatched		Matched	
Grade	Control	Treatment	Control	Treatment
ELA Grade 5	57581	47910	47860	47860
ELA Grade 6	57895	48993	48990	48990
ELA Grade 7	56548	49818	49710	49710
ELA Grade 8	56482	50524	50488	50488
Math Grade 5	57583	47803	47754	47754
Math Grade 6	57918	48960	48957	48957
Math Grade 7	56589	49830	49734	49734
Math Grade 8	56526	50549	50501	50501

Table 4. Covariate Representation for Matched Samples by Subject and Grade.

Subject/ Grade	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 5 (N=47860)								
	Asian	0.036	0.187	0.037	0.188	-0.001	0.002	0.310
	Black	0.057	0.232	0.061	0.240	-0.004	0.019	2.893*
	Hispanic	0.118	0.323	0.115	0.320	0.003	0.009	1.418
	Multi-race	0.045	0.208	0.046	0.210	-0.001	0.003	0.526
	White	0.731	0.443	0.729	0.444	0.002	0.005	0.706
	Gender	0.507	0.500	0.509	0.500	-0.002	0.005	0.711
	City	0.257	0.437	0.255	0.436	0.002	0.005	0.733
	Rural	0.208	0.406	0.209	0.407	-0.001	0.003	0.517
	Suburb	0.309	0.462	0.312	0.463	-0.003	0.007	1.034
	Town	0.226	0.418	0.224	0.417	0.002	0.006	0.890
	Disability	0.132	0.338	0.130	0.336	0.002	0.004	0.671
	ELL	0.058	0.233	0.058	0.233	0.000	0.000	0.014
	Low SES	0.388	0.487	0.375	0.484	0.013	0.027	4.152***
	Separate Setting	0.129	0.335	0.127	0.333	0.002	0.006	0.909
	Text-to-speech	0.164	0.370	0.162	0.369	0.002	0.004	0.639
	ELA Score	558.562	42.996	558.925	43.369	-0.363	0.008	1.298
	Math Score	559.118	47.740	561.131	50.221	-2.013	0.041	6.356***
ELA Grade 6 (N=48990)								
	Asian	0.039	0.194	0.041	0.198	-0.002	0.009	1.340
	Black	0.059	0.235	0.058	0.233	0.001	0.005	0.736
	Hispanic	0.115	0.319	0.115	0.319	0.000	0.001	0.150
	Multi-race	0.044	0.204	0.045	0.207	-0.001	0.006	0.978
	White	0.733	0.442	0.732	0.443	0.001	0.003	0.491
	Gender	0.513	0.500	0.513	0.500	0.000	0.000	0.013
	City	0.248	0.432	0.243	0.429	0.005	0.012	1.812
	Rural	0.211	0.408	0.214	0.410	-0.003	0.009	1.437
	Suburb	0.315	0.465	0.318	0.466	-0.003	0.006	0.872
	Town	0.226	0.418	0.225	0.418	0.001	0.003	0.512
	Disability	0.121	0.326	0.123	0.328	-0.002	0.005	0.820
	ELL	0.046	0.209	0.047	0.212	-0.001	0.006	0.910
	Low SES	0.370	0.483	0.362	0.480	0.008	0.018	2.746*
	Separate Setting	0.113	0.316	0.116	0.320	-0.003	0.009	1.376
	Text-to-speech	0.132	0.338	0.134	0.341	-0.002	0.009	1.336
	ELA Score	588.622	49.086	587.275	49.114	1.347	0.027	4.293***
	Math Score	583.440	47.960	583.514	48.587	-0.074	0.002	0.240

Table 4. Covariate Representation for Matched Samples by Subject and Grade (continued).

Subject/ Grade	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 7 (N=49710)								
	Asian	0.039	0.194	0.038	0.191	0.001	0.008	1.219
	Black	0.065	0.246	0.058	0.234	0.007	-0.029	4.516***
	Hispanic	0.122	0.328	0.115	0.319	0.007	0.023	3.659**
	Multi-race	0.040	0.196	0.042	0.201	-0.002	0.010	1.501
	White	0.722	0.448	0.737	0.440	-0.015	0.034	5.412***
	Gender	0.513	0.500	0.513	0.500	0.000	0.000	0.076
	City	0.263	0.441	0.240	0.427	0.023	0.054	8.476***
	Rural	0.207	0.405	0.215	0.411	-0.008	0.021	3.373**
	Suburb	0.309	0.462	0.316	0.465	-0.007	0.016	2.559
	Town	0.221	0.415	0.228	0.420	-0.007	0.017	2.675
	Disability	0.123	0.328	0.117	0.321	0.006	0.019	2.943*
	ELL	0.051	0.221	0.047	0.211	0.004	0.022	3.525**
	Low SES	0.386	0.487	0.356	0.479	0.030	0.061	9.611***
	Separate Setting	0.117	0.321	0.112	0.315	0.005	0.016	2.482
	Text-to-speech	0.132	0.338	0.125	0.330	0.007	0.022	3.500**
	ELA Score	601.714	47.915	600.490	46.890	1.224	0.026	4.071***
	Math Score	603.881	48.949	607.675	49.767	-3.794	0.077	12.118***
ELA Grade 8 (N=50488)								
	Asian	0.038	0.191	0.037	0.188	0.001	0.007	1.062
	Black	0.062	0.242	0.060	0.237	0.002	0.010	1.604
	Hispanic	0.116	0.320	0.113	0.316	0.003	0.010	1.602
	Multi-race	0.037	0.190	0.040	0.196	-0.003	0.012	1.975
	White	0.735	0.441	0.740	0.439	-0.005	0.011	1.695
	Gender	0.516	0.500	0.518	0.500	-0.002	0.003	0.441
	City	0.251	0.433	0.237	0.425	0.014	0.031	4.917***
	Rural	0.211	0.408	0.218	0.413	-0.007	0.018	2.912*
	Suburb	0.311	0.463	0.311	0.463	0.000	0.001	0.184
	Town	0.227	0.419	0.234	0.423	-0.007	0.015	2.377
	Disability	0.117	0.322	0.118	0.322	-0.001	0.001	0.147
	ELL	0.045	0.207	0.045	0.207	0.000	0.000	0.000
	Low SES	0.359	0.480	0.345	0.475	0.014	0.028	4.415***
	Separate Setting	0.112	0.316	0.113	0.317	-0.001	0.004	0.607
	Text-to-speech	0.122	0.327	0.121	0.327	0.001	0.001	0.212
	ELA Score	613.972	47.266	612.004	48.061	1.968	0.041	6.561***
	Math Score	616.705	53.469	617.617	54.601	-0.912	0.017	2.680

Table 4. Covariate Representation for Matched Samples by Subject and Grade (continued).

Subject/ Grade	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 5 (N=47754)								
	Asian	0.036	0.185	0.037	0.189	-0.001	0.007	1.055
	Black	0.056	0.230	0.060	0.237	-0.004	0.017	2.589
	Hispanic	0.117	0.322	0.115	0.319	0.002	0.006	0.929
	Multi-race	0.045	0.208	0.046	0.210	-0.001	0.003	0.542
	White	0.734	0.442	0.731	0.444	0.003	0.008	1.155
	Gender	0.507	0.500	0.509	0.500	-0.002	0.004	0.589
	City	0.255	0.436	0.254	0.435	0.001	0.004	0.624
	Rural	0.209	0.406	0.209	0.407	0.000	0.002	0.279
	Suburb	0.309	0.462	0.313	0.464	-0.004	0.008	1.168
	Town	0.227	0.419	0.224	0.417	0.003	0.006	0.906
	Disability	0.131	0.338	0.130	0.336	0.001	0.005	0.749
	ELL	0.057	0.232	0.058	0.233	-0.001	0.003	0.529
	Low SES	0.386	0.487	0.374	0.484	0.012	0.026	3.987***
	Multiplication Table	0.039	0.195	0.038	0.191	0.001	0.007	1.090
	Separate Setting	0.129	0.335	0.127	0.333	0.002	0.006	0.921
	Text-to-speech	0.165	0.372	0.164	0.370	0.001	0.004	0.567
	ELA Score	558.743	42.945	559.016	43.338	-0.273	0.006	-0.974
	Math Score	559.264	47.695	561.243	50.151	-1.979	0.040	6.249***
Math Grade 6 (N=48957)								
	Asian	0.040	0.195	0.041	0.197	-0.001	0.005	0.815
	Black	0.057	0.231	0.057	0.232	0.000	0.003	0.414
	Hispanic	0.115	0.319	0.115	0.319	0.000	0.001	0.190
	Multi-race	0.044	0.205	0.045	0.207	-0.001	0.004	0.697
	White	0.734	0.442	0.732	0.443	0.002	0.004	0.657
	Gender	0.512	0.500	0.512	0.500	0.000	0.000	0.030
	City	0.247	0.431	0.243	0.429	0.004	0.011	1.627
	Rural	0.210	0.407	0.215	0.411	-0.005	0.011	1.680
	Suburb	0.316	0.465	0.318	0.466	-0.002	0.004	0.687
	Town	0.227	0.419	0.225	0.417	0.002	0.005	0.742
	Disability	0.121	0.326	0.123	0.328	-0.002	0.006	0.880
	ELL	0.048	0.214	0.047	0.212	0.001	0.002	0.360
	Low SES	0.370	0.483	0.362	0.480	0.008	0.016	2.581
	Multiplication Table	0.040	0.195	0.041	0.198	-0.001	0.007	1.040
	Separate Setting	0.113	0.317	0.115	0.319	-0.002	0.006	0.994
	Text-to-speech	0.135	0.341	0.137	0.344	-0.002	0.006	1.008
	ELA Score	588.656	49.021	587.278	49.125	1.378	0.028	4.393***
	Math Score	583.416	48.100	583.540	48.580	-0.124	0.003	-0.401

Table 4. Covariate Representation for Matched Samples by Subject and Grade (continued).

Subject/ Grade	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 7 (N=49734)								
	Asian	0.039	0.194	0.038	0.191	0.001	0.007	1.187
	Black	0.065	0.246	0.058	0.234	0.007	0.028	4.447***
	Hispanic	0.123	0.329	0.115	0.319	0.008	0.024	3.866***
	Multi-race	0.040	0.196	0.042	0.201	-0.002	0.011	1.722
	White	0.721	0.448	0.736	0.441	-0.015	0.034	5.335***
	Gender	0.514	0.500	0.513	0.500	0.001	0.001	0.171
	City	0.264	0.441	0.241	0.428	0.023	0.054	8.444***
	Rural	0.206	0.404	0.215	0.411	-0.009	0.023	3.624**
	Suburb	0.309	0.462	0.316	0.465	-0.007	0.016	2.579
	Town	0.221	0.415	0.228	0.419	-0.007	0.015	2.386
	Disability	0.125	0.330	0.117	0.321	0.008	0.024	3.806***
	ELL	0.052	0.221	0.047	0.211	0.005	0.023	3.545**
	Low SES	0.387	0.487	0.356	0.479	0.031	0.062	9.836***
	Multiplication Table	0.041	0.199	0.039	0.193	0.002	0.012	1.940
	Separate Setting	0.117	0.322	0.112	0.315	0.005	0.018	2.868*
	Text-to-speech	0.134	0.340	0.125	0.331	0.009	0.025	3.927***
	ELA Score	601.619	47.869	600.470	46.885	1.149	0.024	3.824***
	Math Score	603.800	48.990	607.628	49.824	-3.828	0.078	12.217***
Math Grade 8 (N=50501)								
	Asian	0.037	0.190	0.037	0.188	0.000	0.003	0.533
	Black	0.063	0.242	0.060	0.237	0.003	0.011	1.811
	Hispanic	0.116	0.320	0.113	0.317	0.003	0.009	1.424
	Multi-race	0.037	0.189	0.040	0.196	-0.003	0.014	2.257
	White	0.735	0.441	0.739	0.439	-0.004	0.009	1.416
	Gender	0.516	0.500	0.517	0.500	-0.001	0.003	0.516
	City	0.252	0.434	0.238	0.426	0.014	0.033	5.196***
	Rural	0.211	0.408	0.218	0.413	-0.007	0.017	2.712
	Suburb	0.310	0.463	0.310	0.463	0.000	0.001	0.116
	Town	0.227	0.419	0.233	0.423	-0.006	0.016	2.542
	Disability	0.117	0.322	0.118	0.322	-0.001	0.001	0.117
	ELL	0.045	0.206	0.045	0.207	0.000	0.002	0.396
	Low SES	0.359	0.480	0.346	0.476	0.013	0.028	4.472***
	Multiplication Table	0.035	0.185	0.035	0.185	0.000	0.000	0.017
	Separate Setting	0.112	0.316	0.114	0.317	-0.002	0.004	0.706
	Text-to-speech	0.123	0.328	0.122	0.328	0.001	0.001	0.154
	ELA Score	613.900	47.240	611.973	48.058	1.927	0.040	6.424***
	Math Score	616.731	53.370	617.577	54.642	-0.846	0.016	2.491

Note. N represents size per group.

** p < .05*

*** p < .01*

**** p < .001*

Table 5. Match Quality Indices by Subject and Grade.

Subject/ Grade	Effect Size		Pseudo-R^2	
	Average	Max	Unmatched	Matched
ELA Grade 5	0.009	0.041	0.016	0.001
ELA Grade 6	0.008	0.027	0.012	0.001
ELA Grade 7	0.027	0.077	0.026	0.007
ELA Grade 8	0.012	0.041	0.013	0.002
Math Grade 5	0.009	0.040	0.016	0.001
Math Grade 6	0.007	0.028	0.012	0.001
Math Grade 7	0.027	0.078	0.026	0.007
Math Grade 8	0.012	0.040	0.013	0.002

Table 6. T-Test Results and Effect Sizes of Differences between Control and Treatment Groups by Subject and Grade.

Subject/ Grade	Control		Treatment		Mean				
	Mean	SD	Mean	SD	Diff.	SE	D	*t*	Sig.
ELA Grade 5 (N=47860)	597.246	46.813	594.723	48.228	-2.523	0.307	0.053	8.212	<.001
ELA Grade 6 (N=48990)	611.128	47.749	605.837	49.120	-5.291	0.310	0.109	17.093	<.001
ELA Grade 7 (N=49710)	627.906	53.033	626.962	54.397	-0.944	0.341	0.018	2.770	0.022
ELA Grade 8 (N=50488)	629.609	58.129	629.838	57.705	0.229	0.365	0.004	0.629	1.000
Math Grade 5 (N=47754)	605.589	50.868	596.668	54.920	-8.921	0.343	0.169	26.042	<.001
Math Grade 6 (N=48957)	617.365	55.081	604.318	56.817	-13.047	0.358	0.233	36.482	<.001
Math Grade 7 (N=49734)	628.249	59.122	622.116	59.043	-6.133	0.375	0.104	16.368	<.001
Math Grade 8 (N=50501)	647.362	56.604	640.500	55.853	-6.862	0.354	0.122	19.390	<.001

Note. N represents size per group.

Table 7. T-Test Results and Effect Sizes of Differences between Control and Treatment Groups by Subject, Grade, and Domain.

		Control		Treatment						
Subject/ Grade and Domain	Maximum Points	Mean	SD	Mean	SD	Mean Diff.	SE	D	*t*	Sig.
ELA Grade 5 (N=47860)										
Listening	8	5.026	1.979	4.990	2.015	-0.036	0.013	0.018	2.769	0.022
Reading	24	14.539	4.994	14.228	5.099	-0.311	0.033	0.062	9.525	<.001
Writing/Language	16	9.930	3.329	9.725	3.352	-0.205	0.022	0.061	9.513	<.001
ELA Grade 6 (N=48990)										
Listening	8	5.212	1.892	5.054	1.939	-0.158	0.012	0.082	12.885	<.001
Reading	24	14.204	4.790	13.761	4.887	-0.443	0.031	0.092	14.341	<.001
Writing/Language	16	9.477	3.030	9.184	3.089	-0.293	0.020	0.096	15.006	<.001
ELA Grade 7 (N=49710)										
Listening	8	4.960	1.995	4.930	2.001	-0.030	0.013	0.015	2.308	0.084
Reading	24	13.313	5.141	13.322	5.251	0.009	0.033	0.002	0.272	1.000
Writing/Language	16	9.853	3.108	9.654	3.116	-0.199	0.020	0.064	10.059	<.001
ELA Grade 8 (N=50488)										
Listening	8	4.784	2.014	4.833	2.031	0.049	0.013	0.024	3.836	0.001
Reading	24	13.784	5.379	13.893	5.330	0.109	0.034	0.020	3.246	0.005
Writing/Language	16	10.033	3.241	9.852	3.238	-0.181	0.020	0.056	8.898	<.001
Math Grade 5 (N=47754)										
Geometry	9	4.112	2.371	3.752	2.372	-0.360	0.015	0.152	23.421	<.001
Measurement and Data	10	4.370	2.477	4.216	2.474	-0.154	0.016	0.062	9.600	<.001
Numbers/ Operations - Fractions	9	4.013	2.291	3.770	2.276	-0.243	0.015	0.107	16.504	<.001
Numbers/ Operations in Base Ten	9	4.513	2.414	4.084	2.454	-0.429	0.016	0.176	27.243	<.001
Operations and Algebraic Thinking	9	4.349	2.319	3.911	2.310	-0.438	0.015	0.189	29.202	<.001
Math Grade 6 (N=48957)										
Expressions and Equations	11	5.385	2.903	4.816	2.827	-0.569	0.018	0.199	31.100	<.001
Geometry	7	2.804	1.889	2.482	1.777	-0.322	0.012	0.175	27.449	<.001
Ratios and Proportions	7	3.329	1.833	2.963	1.783	-0.366	0.012	0.202	31.676	<.001
Statistics and Probability	11	5.471	2.313	5.015	2.214	-0.456	0.014	0.201	31.472	<.001
The Number System	10	5.507	2.671	4.898	2.722	-0.609	0.017	0.226	35.345	<.001

Table 7. T-Test Results and Effect Sizes of Differences between Control and Treatment Groups by Subject, Grade, and Domain (continued).

Subject/ Grade and Domain	Maximum Points	Control Mean	Control SD	Treatment Mean	Treatment SD	Mean Diff.	SE	D	*t*	Sig.
Math Grade 7 (N=49734)										
Expressions and Equations	10	4.182	2.425	4.012	2.335	-0.170	0.015	0.071	11.268	<.001
Geometry	10	3.800	1.953	3.713	1.874	-0.087	0.012	0.045	7.171	<.001
Ratios and Proportions	8	4.253	2.241	4.047	2.224	-0.206	0.014	0.093	14.607	<.001
Statistics and Probability	11	5.241	2.711	5.050	2.647	-0.191	0.017	0.072	11.281	<.001
The Number System	7	2.885	2.016	2.628	1.932	-0.257	0.013	0.130	20.516	<.001
Math Grade 8 (N=50501)										
Expressions and Equations	10	4.351	2.551	3.983	2.450	-0.368	0.016	0.147	23.352	<.001
Functions	10	4.600	2.496	4.422	2.437	-0.178	0.016	0.072	11.451	<.001
Geometry	10	4.559	2.589	4.237	2.494	-0.322	0.016	0.127	20.143	<.001
Statistics and Probability	8	3.534	1.850	3.451	1.839	-0.083	0.012	0.045	7.151	<.001
The Number System	8	3.369	2.259	2.941	2.200	-0.428	0.014	0.192	30.526	<.001

Note. N represents size per group.

Table 8. Sample Sizes for Unmatched and Matched Samples by Subject, Grade, and Subgroup.

Subject/ Grade	Subgroup	Unmatched Control	Unmatched Treatment	Matched Control	Matched Treatment
ELA Grade 5					
	Disability	7323	6231	6224	6224
	ELL	4148	2765	2736	2736
	Low SES	24903	17946	17916	17916
ELA Grade 6					
	Disability	7298	6017	6007	6007
	ELL	3221	2311	2265	2265
	Low SES	24330	17719	17717	17717
ELA Grade 7					
	Disability	7022	5798	5705	5705
	ELL	2897	2319	2218	2218
	Low SES	23082	17732	17708	17708
ELA Grade 8					
	Disability	6690	5936	5933	5933
	ELL	2417	2262	2079	2079
	Low SES	21633	17435	17430	17430
Math Grade 5					
	Disability	7330	6202	6195	6195
	ELL	4149	2758	2733	2733
	Low SES	24905	17851	17820	17820
Math Grade 6					
	Disability	7310	6015	6006	6006
	ELL	3224	2320	2279	2279
	Low SES	24350	17705	17703	17703
Math Grade 7					
	Disability	7043	5810	5732	5732
	ELL	2902	2331	2231	2231
	Low SES	23114	17739	17715	17715
Math Grade 8					
	Disability	6709	5944	5940	5940
	ELL	2421	2277	2097	2097
	Low SES	21672	17463	17459	17459

Table 9. Match Quality Indices by Subject, Grade, and Subgroup.

Subject/ Grade	Subgroup	Effect Size		Pseudo-R^2	
		Average	Max	Unmatched	Matched
ELA Grade 5					
	Disability	0.015	0.058	0.018	0.003
	ELL	0.013	0.047	0.029	0.001
	Low SES	0.005	0.010	0.015	0.000
ELA Grade 6					
	Disability	0.013	0.060	0.018	0.001
	ELL	0.018	0.087	0.037	0.002
	Low SES	0.004	0.012	0.015	0.000
ELA Grade 7					
	Disability	0.012	0.057	0.031	0.003
	ELL	0.027	0.106	0.046	0.004
	Low SES	0.016	0.048	0.029	0.002
ELA Grade 8					
	Disability	0.028	0.072	0.019	0.004
	ELL	0.029	0.130	0.028	0.005
	Low SES	0.010	0.027	0.016	0.001
Math Grade 5					
	Disability	0.014	0.064	0.019	0.003
	ELL	0.014	0.051	0.029	0.001
	Low SES	0.004	0.010	0.016	0.000
Math Grade 6					
	Disability	0.011	0.058	0.018	0.001
	ELL	0.016	0.085	0.037	0.002
	Low SES	0.003	0.012	0.015	0.000
Math Grade 7					
	Disability	0.013	0.057	0.031	0.003
	ELL	0.026	0.109	0.046	0.005
	Low SES	0.015	0.049	0.029	0.002
Math Grade 8					
	Disability	0.027	0.068	0.018	0.004
	ELL	0.029	0.131	0.030	0.005
	Low SES	0.009	0.023	0.016	0.001

Table 10. T-Test Results and Effect Sizes of Differences between Control and Treatment Groups by Subgroup.

Subject/ Grade	Subgroup	N	Control Mean	Control SD	Treatment Mean	Treatment SD	Mean Diff.	SE	D	*t*	Sig.
ELA Grade 5											
	Disability	6224	554.580	44.719	554.572	44.415	-0.008	0.799	0.000	0.009	1.000
	ELL	2736	560.192	34.852	554.705	35.211	-5.487	0.947	0.157	5.793	<.001
	Low SES	17916	578.180	44.286	574.425	44.903	-3.755	0.471	0.084	7.968	<.001
ELA Grade 6											
	Disability	6007	562.090	44.184	560.633	46.965	-1.457	0.832	0.032	1.751	0.240
	ELL	2265	568.801	35.648	558.604	38.214	-10.197	1.098	0.276	9.284	<.001
	Low SES	17717	591.171	46.027	585.315	47.641	-5.856	0.498	0.125	11.768	<.001
ELA Grade 7											
	Disability	5705	575.915	46.436	576.416	48.818	0.501	0.892	0.011	-0.561	1.000
	ELL	2218	580.041	37.878	574.942	39.027	-5.099	1.155	0.133	4.415	<.001
	Low SES	17708	605.836	49.925	604.421	51.735	-1.415	0.540	0.028	2.619	0.027
ELA Grade 8											
	Disability	5933	571.979	52.882	575.193	52.392	3.214	0.967	0.061	-3.326	0.003
	ELL	2079	578.309	45.278	579.307	43.058	0.998	1.371	0.023	-0.729	1.000
	Low SES	17430	605.688	56.100	607.096	55.271	1.408	0.597	0.025	-2.361	0.055
Math Grade 5											
	Disability	6195	558.555	61.961	551.287	63.708	-7.268	1.129	0.116	6.436	<.001
	ELL	2733	569.521	50.628	551.644	55.077	-17.877	1.431	0.338	12.491	<.001
	Low SES	17820	585.027	53.597	572.044	56.986	-12.983	0.586	0.235	22.154	<.001
Math Grade 6											
	Disability	6006	561.308	59.134	552.993	60.135	-8.315	1.088	0.139	7.639	<.001
	ELL	2279	569.158	48.513	550.184	50.554	-18.974	1.468	0.383	12.925	<.001
	Low SES	17703	593.600	54.459	578.393	56.206	-15.207	0.588	0.275	25.853	<.001
Math Grade 7											
	Disability	5732	571.938	61.453	566.428	62.374	-5.510	1.157	0.089	4.764	<.001
	ELL	2231	575.745	52.751	565.977	53.451	-9.768	1.590	0.184	6.143	<.001
	Low SES	17715	604.113	58.934	595.592	59.278	-8.521	0.628	0.144	13.568	<.001
Math Grade 8											
	Disability	5940	593.453	57.789	590.304	55.351	-3.149	1.038	0.056	3.032	0.007
	ELL	2097	600.249	48.122	593.457	48.543	-6.792	1.493	0.141	4.549	<.001
	Low SES	17459	623.653	56.149	615.792	54.283	-7.861	0.591	0.142	13.300	<.001

Note. N represents size per group.

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Appendix

Table 11. Covariate Representation of Unmatched Datasets by Subject and Grade.

Subject/ Grade	Covariate	Control			Treatment			Mean Diff.	D	Z/t
		N	Mean	SD	N	Mean	SD			
ELA Grade 5										
	Asian	57581	0.039	0.195	47904	0.037	0.188	-0.003	0.013	2.141
	Black	57581	0.090	0.286	47904	0.061	0.240	-0.029	0.109	17.547***
	Hispanic	57581	0.128	0.334	47904	0.115	0.319	-0.012	0.038	6.08***
	Multi-race	57581	0.042	0.201	47904	0.046	0.210	0.004	0.019	3.103*
	White	57581	0.690	0.463	47904	0.729	0.444	0.040	0.087	14.121***
	Gender	57581	0.510	0.500	47904	0.509	0.500	-0.001	0.002	0.298
	City	57581	0.313	0.464	47904	0.255	0.436	-0.058	0.129	20.742***
	Rural	57581	0.187	0.390	47904	0.209	0.407	0.022	0.055	8.911***
	Suburb	57581	0.292	0.454	47904	0.312	0.463	0.021	0.045	7.237***
	Town	57581	0.208	0.406	47904	0.224	0.417	0.016	0.038	6.118***
	Disability	57581	0.127	0.333	47904	0.130	0.336	0.003	0.009	1.399
	ELL	57581	0.072	0.259	47904	0.058	0.233	-0.014	0.058	9.356***
	Low SES	57581	0.432	0.495	47904	0.375	0.484	-0.058	0.118	19.052***
	Separate Setting	57581	0.132	0.339	47904	0.127	0.333	-0.005	0.016	2.562
	Text-to-speech	57581	0.177	0.382	47904	0.162	0.369	-0.015	0.040	6.405***
	ELA Score	57581	560.961	46.400	47904	558.987	43.407	-1.974	0.044	7.126***
	Math Score	57581	557.145	47.851	47904	561.309	50.543	4.164	0.085	13.649***
ELA Grade 6										
	Asian	57895	0.039	0.194	48990	0.041	0.198	0.002	0.008	1.311
	Black	57895	0.088	0.284	48990	0.058	0.233	-0.031	0.117	18.94***
	Hispanic	57895	0.124	0.329	48990	0.115	0.319	-0.009	0.028	4.591***
	Multi-race	57895	0.041	0.198	48990	0.045	0.207	0.004	0.021	3.374**
	White	57895	0.696	0.460	48990	0.732	0.443	0.035	0.078	12.675***
	Gender	57895	0.514	0.500	48990	0.513	0.500	-0.001	0.002	0.325
	City	57895	0.300	0.458	48990	0.243	0.429	-0.057	0.128	20.808***
	Rural	57895	0.192	0.394	48990	0.214	0.410	0.022	0.055	8.94***
	Suburb	57895	0.294	0.455	48990	0.318	0.466	0.024	0.052	8.475***
	Town	57895	0.214	0.410	48990	0.225	0.418	0.011	0.027	4.32***
	Disability	57895	0.126	0.332	48990	0.123	0.328	-0.003	0.010	1.596
	ELL	57895	0.056	0.229	48990	0.047	0.212	-0.009	0.038	6.223***
	Low SES	57895	0.420	0.494	48990	0.362	0.480	-0.059	0.120	19.527***
	Separate Setting	57895	0.120	0.325	48990	0.116	0.320	-0.004	0.013	2.093
	Text-to-speech	57895	0.145	0.352	48990	0.134	0.341	-0.011	0.031	4.97***
	ELA Score	57895	587.582	51.601	48990	587.275	49.114	-0.306	0.006	0.993
	Math Score	57895	577.093	53.708	48990	583.514	48.587	6.421	0.125	20.509***

Table 11. Covariate Representation of Unmatched Datasets by Subject and Grade (continued).

Subject/ Grade	Covariate	Control			Treatment			Mean Diff.	D	Z/t
		N	Mean	SD	N	Mean	SD			
ELA Grade 7										
	Asian	56548	0.040	0.195	49805	0.038	0.191	-0.002	0.010	1.705
	Black	56548	0.086	0.281	49805	0.058	0.234	-0.028	0.109	17.687***
	Hispanic	56548	0.125	0.331	49805	0.115	0.319	-0.010	0.031	4.985***
	Multi-race	56548	0.038	0.191	49805	0.042	0.201	0.004	0.022	3.589**
	White	56548	0.700	0.458	49805	0.737	0.440	0.038	0.084	13.592***
	Gender	56548	0.513	0.500	49805	0.513	0.500	-0.001	0.001	0.208
	City	56548	0.297	0.457	49805	0.240	0.427	-0.057	0.128	20.836***
	Rural	56548	0.194	0.396	49805	0.216	0.411	0.021	0.052	8.518***
	Suburb	56548	0.298	0.458	49805	0.316	0.465	0.018	0.039	6.34***
	Town	56548	0.210	0.408	49805	0.228	0.420	0.018	0.043	7.004***
	Disability	56548	0.124	0.330	49805	0.116	0.321	-0.008	0.024	3.88***
	ELL	56548	0.051	0.220	49805	0.047	0.211	-0.005	0.022	3.518**
	Low SES	56548	0.408	0.491	49805	0.356	0.479	-0.052	0.108	17.453***
	Separate Setting	56548	0.113	0.317	49805	0.112	0.315	-0.002	0.005	0.827
	Text-to-speech	56548	0.133	0.340	49805	0.124	0.330	-0.009	0.027	4.394***
	ELA Score	56548	605.530	50.161	49805	600.492	46.915	-5.037	0.104	16.915***
	Math Score	56548	602.393	49.749	49805	607.737	49.777	5.344	0.107	17.474***
ELA Grade 8										
	Asian	56479	0.038	0.192	50521	0.037	0.188	-0.002	0.008	1.334
	Black	56479	0.084	0.278	50521	0.060	0.237	-0.024	0.094	15.365***
	Hispanic	56479	0.118	0.323	50521	0.113	0.316	-0.006	0.018	2.875*
	Multi-race	56479	0.035	0.185	50521	0.040	0.196	0.005	0.024	3.953***
	White	56479	0.713	0.453	50521	0.740	0.439	0.027	0.061	9.95***
	Gender	56479	0.512	0.500	50521	0.518	0.500	0.006	0.011	1.841
	City	56479	0.287	0.453	50521	0.237	0.425	-0.050	0.114	18.574***
	Rural	56479	0.198	0.398	50521	0.218	0.413	0.021	0.051	8.375***
	Suburb	56479	0.301	0.459	50521	0.311	0.463	0.010	0.021	3.432**
	Town	56479	0.214	0.410	50521	0.234	0.423	0.020	0.047	7.698***
	Disability	56479	0.118	0.323	50521	0.117	0.322	-0.001	0.003	0.484
	ELL	56479	0.043	0.202	50521	0.045	0.207	0.002	0.010	1.58
	Low SES	56479	0.383	0.486	50521	0.345	0.475	-0.038	0.079	12.863***
	Separate Setting	56479	0.109	0.311	50521	0.113	0.317	0.005	0.015	2.481
	Text-to-speech	56479	0.125	0.331	50521	0.121	0.327	-0.004	0.012	2.005
	ELA Score	56479	616.730	49.092	50521	612.035	48.092	-4.695	0.097	15.787***
	Math Score	56479	615.708	53.665	50521	617.744	54.839	2.036	0.038	6.125***

Table 11. Covariate Representation of Unmatched Datasets by Subject and Grade (continued).

Subject/ Grade	Covariate	Control			Treatment			Mean Diff.	D	Z/t
		N	Mean	SD	N	Mean	SD			
Math Grade 5										
	Asian	57583	0.039	0.195	47797	0.037	0.189	-0.002	0.013	2.033
	Black	57583	0.090	0.287	47797	0.060	0.237	-0.031	0.115	18.518***
	Hispanic	57583	0.128	0.334	47797	0.115	0.319	-0.012	0.038	6.148***
	Multi-race	57583	0.042	0.201	47797	0.046	0.210	0.004	0.020	3.144*
	White	57583	0.690	0.463	47797	0.731	0.444	0.041	0.091	14.645***
	Gender	57583	0.510	0.500	47797	0.509	0.500	-0.001	0.002	0.369
	City	57583	0.313	0.464	47797	0.254	0.435	-0.059	0.132	21.235***
	Rural	57583	0.187	0.390	47797	0.209	0.407	0.022	0.056	9.07***
	Suburb	57583	0.292	0.454	47797	0.313	0.464	0.021	0.046	7.458***
	Town	57583	0.208	0.406	47797	0.224	0.417	0.016	0.039	6.239***
	Disability	57583	0.127	0.333	47797	0.130	0.336	0.003	0.008	1.19
	ELL	57583	0.072	0.259	47797	0.058	0.233	-0.014	0.058	9.371***
	Low SES	57583	0.433	0.495	47797	0.373	0.484	-0.059	0.120	19.428***
	Multiplication Table	57583	0.038	0.192	47797	0.038	0.191	0.000	0.001	0.179
	Separate Setting	57583	0.133	0.339	47797	0.127	0.333	-0.006	0.018	2.884*
	Text-to-speech	57583	0.181	0.385	47797	0.164	0.370	-0.017	0.045	7.254***
	ELA Score	57583	560.945	46.404	47797	559.075	43.370	-1.870	0.042	6.749***
	Math Score	57583	557.133	47.865	47797	561.417	50.464	4.284	0.087	14.043***
Math Grade 6										
	Asian	57918	0.039	0.194	48957	0.041	0.197	0.002	0.008	1.231
	Black	57918	0.088	0.284	48957	0.057	0.232	-0.031	0.119	19.344***
	Hispanic	57918	0.124	0.329	48957	0.115	0.319	-0.009	0.027	4.419***
	Multi-race	57918	0.041	0.198	48957	0.045	0.207	0.004	0.020	3.222*
	White	57918	0.696	0.460	48957	0.732	0.443	0.036	0.079	12.876***
	Gender	57918	0.514	0.500	48957	0.512	0.500	-0.001	0.003	0.447
	City	57918	0.300	0.458	48957	0.243	0.429	-0.057	0.128	20.861***
	Rural	57918	0.192	0.394	48957	0.215	0.411	0.022	0.056	9.043***
	Suburb	57918	0.294	0.455	48957	0.318	0.466	0.024	0.052	8.502***
	Town	57918	0.214	0.410	48957	0.225	0.417	0.011	0.026	4.251***
	Disability	57918	0.126	0.332	48957	0.123	0.328	-0.003	0.010	1.652
	ELL	57918	0.056	0.229	48957	0.047	0.212	-0.008	0.037	6.079***
	Low SES	57918	0.420	0.494	48957	0.362	0.480	-0.059	0.121	19.598***
	Multiplication Table	57918	0.041	0.199	48957	0.041	0.198	-0.001	0.003	0.455
	Separate Setting	57918	0.120	0.325	48957	0.115	0.319	-0.005	0.014	2.337
	Text-to-speech	57918	0.148	0.356	48957	0.137	0.344	-0.012	0.033	5.372***
	ELA Score	57918	587.547	51.631	48957	587.278	49.125	-0.270	0.005	0.873
	Math Score	57918	577.069	53.739	48957	583.540	48.580	6.471	0.126	20.662***

Table 11. Covariate Representation of Unmatched Datasets by Subject and Grade (continued).

Subject/ Grade	Covariate	Control			Treatment			Mean Diff.	D	Z/t
		N	Mean	SD	N	Mean	SD			
Math Grade 7										
	Asian	56589	0.040	0.195	49817	0.038	0.191	-0.002	0.010	1.636
	Black	56589	0.086	0.281	49817	0.058	0.234	-0.028	0.109	17.694***
	Hispanic	56589	0.125	0.330	49817	0.115	0.319	-0.010	0.030	4.823***
	Multi-race	56589	0.038	0.191	49817	0.042	0.201	0.005	0.023	3.727**
	White	56589	0.699	0.458	49817	0.737	0.440	0.037	0.082	13.395***
	Gender	56589	0.514	0.500	49817	0.513	0.500	-0.001	0.002	0.304
	City	56589	0.297	0.457	49817	0.241	0.427	-0.056	0.127	20.659***
	Rural	56589	0.194	0.396	49817	0.215	0.411	0.021	0.052	8.442***
	Suburb	56589	0.298	0.457	49817	0.316	0.465	0.018	0.039	6.396***
	Town	56589	0.210	0.408	49817	0.228	0.419	0.017	0.042	6.835***
	Disability	56589	0.124	0.330	49817	0.117	0.321	-0.008	0.024	3.912***
	ELL	56589	0.051	0.221	49817	0.047	0.211	-0.005	0.021	3.38**
	Low SES	56589	0.408	0.492	49817	0.356	0.479	-0.052	0.108	17.527***
	Multiplication Table	56589	0.040	0.197	49817	0.039	0.193	-0.002	0.008	1.311
	Separate Setting	56589	0.114	0.317	49817	0.112	0.315	-0.002	0.007	1.127
	Text-to-speech	56589	0.136	0.343	49817	0.125	0.331	-0.011	0.031	5.102***
	ELA Score	56589	605.504	50.181	49817	600.479	46.918	-5.025	0.103	16.874***
	Math Score	56589	602.385	49.736	49817	607.693	49.844	5.308	0.107	17.351***
Math Grade 8										
	Asian	56523	0.038	0.192	50546	0.037	0.188	-0.001	0.007	1.239
	Black	56523	0.084	0.278	50546	0.060	0.237	-0.025	0.094	15.421***
	Hispanic	56523	0.118	0.323	50546	0.113	0.317	-0.006	0.017	2.817*
	Multi-race	56523	0.035	0.184	50546	0.040	0.196	0.005	0.024	3.997***
	White	56523	0.712	0.453	50546	0.739	0.439	0.027	0.060	9.85***
	Gender	56523	0.512	0.500	50546	0.517	0.500	0.005	0.010	1.649
	City	56523	0.288	0.453	50546	0.238	0.426	-0.050	0.114	18.554***
	Rural	56523	0.198	0.398	50546	0.218	0.413	0.021	0.051	8.368***
	Suburb	56523	0.301	0.459	50546	0.310	0.463	0.010	0.021	3.423**
	Town	56523	0.214	0.410	50546	0.233	0.423	0.020	0.047	7.715***
	Disability	56523	0.119	0.323	50546	0.118	0.322	-0.001	0.003	0.556
	ELL	56523	0.043	0.202	50546	0.045	0.207	0.002	0.011	1.767
	Low SES	56523	0.383	0.486	50546	0.345	0.476	-0.038	0.079	12.867***
	Multiplication Table	56523	0.036	0.185	50546	0.036	0.185	0.000	0.000	0.006
	Separate Setting	56523	0.109	0.312	50546	0.113	0.317	0.004	0.013	2.134
	Text-to-speech	56523	0.128	0.334	50546	0.122	0.328	-0.005	0.015	2.498
	ELA Score	56523	616.688	49.106	50546	611.982	48.110	-4.706	0.097	15.823***
	Math Score	56523	615.682	53.671	50546	617.698	54.885	2.016	0.037	6.062***

** p < .05*
*** p < .01*
**** p < .001*

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup.

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 5 Disability (N=6224)								
	Asian	0.028	0.164	0.027	0.161	-0.001	0.007	0.386
	Black	0.091	0.288	0.093	0.290	0.002	0.007	0.372
	Hispanic	0.141	0.348	0.133	0.340	-0.008	0.023	1.277
	Multi-race	0.055	0.229	0.056	0.230	0.001	0.003	0.156
	White	0.667	0.471	0.673	0.469	0.006	0.013	0.706
	Gender	0.676	0.468	0.672	0.469	-0.004	0.008	0.440
	City	0.309	0.462	0.294	0.456	-0.015	0.032	1.777
	Rural	0.207	0.405	0.220	0.414	0.013	0.033	1.815
	Suburb	0.256	0.436	0.260	0.439	0.004	0.010	0.533
	Town	0.228	0.419	0.225	0.417	-0.003	0.007	0.386
	ELL	0.088	0.284	0.084	0.277	-0.004	0.015	0.862
	Low SES	0.564	0.496	0.535	0.499	-0.029	0.058	3.243
	Separate Setting	0.733	0.442	0.733	0.443	-0.001	0.001	0.081
	Text-to-speech	0.663	0.473	0.664	0.472	0.001	0.002	0.114
	ELA Score	520.930	40.805	520.111	41.109	-0.819	0.020	1.116
	Math Score	515.772	54.505	515.547	57.991	-0.225	0.004	0.223
ELA Grade 5 ELL (N=2736)								
	Asian	0.220	0.415	0.224	0.417	0.004	0.009	0.325
	Black	0.022	0.148	0.023	0.149	0.000	0.003	0.091
	Hispanic	0.683	0.465	0.679	0.467	-0.005	0.010	0.377
	Multi-race	0.009	0.093	0.009	0.095	0.000	0.004	0.144
	White	0.064	0.245	0.065	0.246	0.000	0.002	0.055
	Gender	0.536	0.499	0.544	0.498	0.008	0.017	0.624
	City	0.546	0.498	0.530	0.499	-0.016	0.032	1.193
	Rural	0.091	0.287	0.101	0.301	0.010	0.035	1.286
	Suburb	0.214	0.410	0.217	0.412	0.003	0.008	0.296
	Town	0.150	0.357	0.152	0.359	0.003	0.007	0.264
	Disability	0.180	0.384	0.185	0.388	0.004	0.011	0.420
	Low SES	0.755	0.430	0.735	0.441	-0.021	0.047	1.737
	Separate Setting	0.282	0.450	0.284	0.451	0.002	0.005	0.180
	Text-to-speech	0.516	0.500	0.522	0.500	0.007	0.013	0.487
	ELA Score	519.616	33.283	519.867	33.081	0.251	0.008	0.279
	Math Score	519.773	44.240	519.641	44.469	-0.132	0.003	0.110
ELA Grade 5 Low SES (N=17916)								
	Asian	0.043	0.203	0.044	0.205	0.001	0.004	0.415
	Black	0.122	0.327	0.125	0.331	0.003	0.010	0.947
	Hispanic	0.209	0.407	0.208	0.406	-0.001	0.002	0.208
	Multi-race	0.065	0.246	0.065	0.246	0.000	0.000	0.021
	White	0.540	0.498	0.536	0.499	-0.004	0.008	0.795
	Gender	0.501	0.500	0.503	0.500	0.002	0.004	0.391
	City	0.357	0.479	0.360	0.480	0.003	0.006	0.562
	Rural	0.215	0.411	0.215	0.411	0.000	0.001	0.103
	Suburb	0.210	0.407	0.209	0.407	-0.001	0.002	0.156
	Town	0.218	0.413	0.215	0.411	-0.003	0.006	0.603
	Disability	0.186	0.389	0.186	0.389	0.000	0.000	0.027
	ELL	0.112	0.315	0.112	0.316	0.001	0.002	0.218
	Separate Setting	0.183	0.387	0.184	0.387	0.001	0.002	0.205
	Text-to-speech	0.250	0.433	0.254	0.435	0.004	0.008	0.779
	ELA Score	541.422	41.859	541.856	42.411	0.434	0.010	0.975
	Math Score	540.411	48.443	540.718	50.172	0.307	0.006	0.589

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 6 Disability (N=6007)								
	Asian	0.028	0.164	0.026	0.160	-0.001	0.008	0.451
	Black	0.095	0.293	0.094	0.292	0.000	0.001	0.062
	Hispanic	0.129	0.335	0.127	0.333	-0.002	0.006	0.328
	Multi-race	0.052	0.222	0.055	0.228	0.003	0.013	0.729
	White	0.678	0.467	0.679	0.467	0.001	0.002	0.117
	Gender	0.668	0.471	0.661	0.474	-0.008	0.017	0.908
	City	0.277	0.447	0.269	0.444	-0.007	0.016	0.881
	Rural	0.217	0.412	0.224	0.417	0.008	0.018	0.990
	Suburb	0.268	0.443	0.273	0.445	0.005	0.012	0.637
	Town	0.238	0.426	0.233	0.423	-0.005	0.013	0.688
	ELL	0.075	0.264	0.075	0.264	0.000	0.000	0.000
	Low SES	0.548	0.498	0.518	0.500	-0.030	0.060	3.292
	Separate Setting	0.775	0.418	0.778	0.416	0.003	0.008	0.438
	Text-to-speech	0.659	0.474	0.661	0.473	0.002	0.004	0.193
	ELA Score	542.730	44.919	541.592	44.736	-1.138	0.025	1.391
	Math Score	535.775	54.171	535.811	54.401	0.036	0.001	0.036
ELA Grade 6 ELL (N=2265)								
	Asian	0.215	0.411	0.216	0.412	0.002	0.004	0.145
	Black	0.030	0.171	0.030	0.171	0.000	0.000	0.000
	Hispanic	0.691	0.462	0.681	0.466	-0.010	0.021	0.704
	Multi-race	0.008	0.089	0.009	0.094	0.001	0.010	0.326
	White	0.055	0.228	0.062	0.241	0.007	0.028	0.950
	Gender	0.550	0.498	0.553	0.497	0.003	0.006	0.209
	City	0.544	0.498	0.532	0.499	-0.012	0.024	0.805
	Rural	0.095	0.293	0.108	0.310	0.013	0.042	1.428
	Suburb	0.205	0.404	0.202	0.401	-0.004	0.009	0.295
	Town	0.155	0.362	0.158	0.365	0.003	0.007	0.245
	Disability	0.192	0.394	0.196	0.397	0.004	0.010	0.338
	Low SES	0.782	0.413	0.745	0.436	-0.037	0.087	2.938
	Separate Setting	0.255	0.436	0.263	0.440	0.008	0.018	0.610
	Text-to-speech	0.436	0.496	0.438	0.496	0.002	0.004	0.120
	ELA Score	538.941	33.236	538.633	33.097	-0.308	0.009	0.312
	Math Score	535.171	43.830	535.388	44.267	0.217	0.005	0.166
ELA Grade 6 Low SES (N=17717)								
	Asian	0.052	0.222	0.052	0.221	0.000	0.001	0.048
	Black	0.118	0.323	0.119	0.323	0.001	0.002	0.132
	Hispanic	0.209	0.407	0.210	0.407	0.001	0.002	0.196
	Multi-race	0.064	0.245	0.065	0.247	0.001	0.004	0.345
	White	0.537	0.499	0.535	0.499	-0.002	0.004	0.384
	Gender	0.516	0.500	0.512	0.500	-0.004	0.008	0.765
	City	0.348	0.476	0.346	0.476	-0.003	0.005	0.491
	Rural	0.215	0.411	0.217	0.412	0.003	0.006	0.568
	Suburb	0.214	0.410	0.214	0.410	0.000	0.001	0.039
	Town	0.223	0.416	0.223	0.416	0.000	0.001	0.038
	Disability	0.175	0.380	0.176	0.380	0.000	0.001	0.070
	ELL	0.095	0.293	0.096	0.294	0.001	0.003	0.254
	Separate Setting	0.165	0.371	0.166	0.372	0.001	0.003	0.258
	Text-to-speech	0.196	0.397	0.199	0.400	0.004	0.010	0.894
	ELA Score	568.196	46.435	567.637	46.470	-0.559	0.012	1.133
	Math Score	562.669	47.621	562.537	48.705	-0.132	0.003	0.257

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 7 Disability (N=5705)								
	Asian	0.024	0.152	0.023	0.149	-0.001	0.007	0.374
	Black	0.097	0.296	0.096	0.294	-0.001	0.004	0.190
	Hispanic	0.143	0.350	0.139	0.346	-0.004	0.011	0.565
	Multi-race	0.052	0.222	0.054	0.225	0.002	0.008	0.419
	White	0.668	0.471	0.672	0.469	0.004	0.009	0.458
	Gender	0.679	0.467	0.682	0.466	0.003	0.007	0.382
	City	0.288	0.453	0.276	0.447	-0.012	0.026	1.394
	Rural	0.216	0.412	0.221	0.415	0.004	0.010	0.544
	Suburb	0.270	0.444	0.273	0.445	0.003	0.006	0.295
	Town	0.224	0.417	0.229	0.420	0.005	0.013	0.671
	ELL	0.084	0.277	0.084	0.278	0.000	0.001	0.067
	Low SES	0.563	0.496	0.535	0.499	-0.028	0.057	3.029
	Separate Setting	0.783	0.412	0.787	0.410	0.004	0.010	0.501
	Text-to-speech	0.655	0.475	0.655	0.475	0.001	0.002	0.079
	ELA Score	552.836	43.060	552.033	42.297	-0.803	0.019	1.005
	Math Score	555.838	56.302	555.445	59.331	-0.393	0.007	0.363
ELA Grade 7 ELL (N=2218)								
	Asian	0.219	0.414	0.217	0.412	-0.002	0.006	0.182
	Black	0.031	0.174	0.029	0.169	-0.002	0.011	0.351
	Hispanic	0.694	0.461	0.690	0.463	-0.005	0.010	0.325
	Multi-race	0.006	0.076	0.007	0.085	0.001	0.017	0.559
	White	0.049	0.216	0.056	0.231	0.007	0.032	1.075
	Gender	0.555	0.497	0.560	0.496	0.005	0.009	0.302
	City	0.587	0.492	0.550	0.498	-0.037	0.076	2.516
	Rural	0.087	0.283	0.098	0.298	0.011	0.037	1.242
	Suburb	0.186	0.389	0.195	0.396	0.009	0.023	0.765
	Town	0.140	0.347	0.157	0.364	0.018	0.050	1.646
	Disability	0.198	0.398	0.204	0.403	0.006	0.015	0.487
	Low SES	0.799	0.401	0.755	0.430	-0.044	0.106	3.534
	Separate Setting	0.264	0.441	0.271	0.445	0.008	0.017	0.577
	Text-to-speech	0.440	0.496	0.442	0.497	0.002	0.004	0.121
	ELA Score	552.247	32.696	551.984	31.690	-0.263	0.008	0.272
	Math Score	559.128	47.653	558.865	49.441	-0.262	0.005	0.180
ELA Grade 7 Low SES (N=17708)								
	Asian	0.051	0.220	0.049	0.215	-0.003	0.012	1.172
	Black	0.123	0.328	0.120	0.325	-0.003	0.009	0.797
	Hispanic	0.212	0.409	0.207	0.405	-0.005	0.012	1.110
	Multi-race	0.059	0.235	0.060	0.237	0.001	0.004	0.383
	White	0.534	0.499	0.545	0.498	0.011	0.022	2.026
	Gender	0.512	0.500	0.515	0.500	0.003	0.006	0.553
	City	0.355	0.479	0.344	0.475	-0.011	0.024	2.217
	Rural	0.216	0.411	0.221	0.415	0.005	0.013	1.196
	Suburb	0.211	0.408	0.214	0.410	0.003	0.007	0.637
	Town	0.218	0.413	0.221	0.415	0.003	0.008	0.732
	Disability	0.181	0.385	0.173	0.379	-0.008	0.022	2.017
	ELL	0.101	0.301	0.096	0.294	-0.005	0.018	1.677
	Separate Setting	0.176	0.380	0.166	0.372	-0.009	0.025	2.344
	Text-to-speech	0.198	0.398	0.190	0.392	-0.008	0.020	1.842
	ELA Score	580.667	44.618	580.610	44.132	-0.057	0.001	0.121
	Math Score	584.526	50.322	586.977	51.269	2.451	0.048	4.54***

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
ELA Grade 8 Disability (N=5933)								
	Asian	0.024	0.153	0.023	0.151	-0.001	0.005	0.302
	Black	0.112	0.315	0.102	0.302	-0.010	0.033	1.812
	Hispanic	0.137	0.344	0.134	0.340	-0.003	0.009	0.483
	Multi-race	0.043	0.203	0.047	0.211	0.004	0.017	0.931
	White	0.662	0.473	0.675	0.468	0.013	0.027	1.482
	Gender	0.674	0.469	0.683	0.465	0.009	0.020	1.101
	City	0.300	0.458	0.268	0.443	-0.032	0.072	3.889**
	Rural	0.222	0.416	0.234	0.424	0.012	0.029	1.597
	Suburb	0.252	0.434	0.254	0.435	0.002	0.004	0.232
	Town	0.226	0.418	0.244	0.429	0.018	0.042	2.274
	ELL	0.082	0.274	0.082	0.274	0.000	0.001	0.067
	Low SES	0.558	0.497	0.528	0.499	-0.030	0.060	3.280
	Separate Setting	0.781	0.414	0.797	0.402	0.016	0.040	2.161
	Text-to-speech	0.648	0.478	0.661	0.473	0.013	0.027	1.467
	ELA Score	561.434	43.736	558.965	43.783	-2.469	0.056	3.073
	Math Score	556.983	57.554	557.074	58.604	0.092	0.002	0.086
ELA Grade 8 ELL (N=2079)								
	Asian	0.216	0.411	0.218	0.413	0.002	0.005	0.151
	Black	0.031	0.174	0.029	0.169	-0.002	0.011	0.362
	Hispanic	0.699	0.459	0.692	0.462	-0.007	0.015	0.472
	Multi-race	0.007	0.085	0.008	0.087	0.001	0.006	0.180
	White	0.046	0.210	0.053	0.224	0.007	0.031	1.001
	Gender	0.567	0.495	0.573	0.495	0.006	0.012	0.376
	City	0.571	0.495	0.538	0.499	-0.033	0.067	2.153
	Rural	0.086	0.281	0.104	0.305	0.018	0.061	1.957
	Suburb	0.204	0.403	0.210	0.407	0.005	0.013	0.421
	Town	0.138	0.345	0.148	0.355	0.010	0.029	0.93
	Disability	0.210	0.407	0.211	0.408	0.001	0.003	0.076
	Low SES	0.803	0.398	0.749	0.433	-0.054	0.130	4.168***
	Separate Setting	0.268	0.443	0.276	0.447	0.007	0.016	0.523
	Text-to-speech	0.437	0.496	0.436	0.496	-0.001	0.002	0.063
	ELA Score	562.886	36.666	563.584	36.177	0.698	0.019	0.618
	Math Score	561.792	48.043	563.750	48.677	1.959	0.041	1.306
ELA Grade 8 Low SES (N=17430)								
	Asian	0.050	0.219	0.048	0.214	-0.002	0.010	0.966
	Black	0.128	0.334	0.125	0.331	-0.003	0.008	0.725
	Hispanic	0.206	0.404	0.204	0.403	-0.002	0.005	0.478
	Multi-race	0.055	0.228	0.058	0.235	0.003	0.015	1.366
	White	0.539	0.498	0.542	0.498	0.003	0.005	0.505
	Gender	0.515	0.500	0.520	0.500	0.005	0.011	1.008
	City	0.349	0.477	0.339	0.473	-0.010	0.021	1.973
	Rural	0.221	0.415	0.225	0.418	0.004	0.010	0.952
	Suburb	0.208	0.406	0.204	0.403	-0.004	0.010	0.914
	Town	0.222	0.415	0.232	0.422	0.010	0.023	2.187
	Disability	0.180	0.384	0.180	0.384	-0.001	0.002	0.14
	ELL	0.093	0.291	0.093	0.291	0.000	0.001	0.055
	Separate Setting	0.170	0.375	0.170	0.375	0.000	0.000	0.029
	Text-to-speech	0.182	0.386	0.182	0.386	0.000	0.000	0.000
	ELA Score	593.086	46.809	591.841	47.028	-1.245	0.027	2.476
	Math Score	593.321	53.780	593.787	54.623	0.466	0.009	0.803

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 5 Disability (N=6195)								
	Asian	0.027	0.161	0.027	0.161	0.000	0.000	0.000
	Black	0.088	0.283	0.090	0.286	0.002	0.007	0.379
	Hispanic	0.141	0.348	0.134	0.341	-0.007	0.020	1.122
	Multi-race	0.056	0.229	0.056	0.231	0.001	0.004	0.196
	White	0.672	0.469	0.676	0.468	0.003	0.007	0.402
	Gender	0.676	0.468	0.672	0.469	-0.004	0.008	0.441
	City	0.308	0.461	0.292	0.455	-0.016	0.035	1.922
	Rural	0.208	0.406	0.221	0.415	0.013	0.032	1.772
	Suburb	0.255	0.436	0.261	0.439	0.007	0.015	0.842
	Town	0.229	0.420	0.225	0.418	-0.004	0.009	0.493
	ELL	0.087	0.282	0.084	0.278	-0.003	0.010	0.578
	Low SES	0.565	0.496	0.533	0.499	-0.032	0.064	3.539
	Multiplication Table	0.280	0.449	0.277	0.448	-0.003	0.007	0.381
	Separate Setting	0.732	0.443	0.731	0.444	-0.002	0.003	0.182
	Text-to-speech	0.672	0.469	0.671	0.470	-0.001	0.002	0.096
	ELA Score	520.770	40.915	520.205	41.185	-0.566	0.014	0.767
	Math Score	515.846	54.517	515.704	57.929	-0.142	0.003	0.140
Math Grade 5 ELL (N=2733)								
	Asian	0.228	0.420	0.224	0.417	-0.004	0.010	0.356
	Black	0.023	0.151	0.023	0.149	-0.001	0.005	0.18
	Hispanic	0.677	0.468	0.678	0.467	0.001	0.002	0.087
	Multi-race	0.010	0.097	0.010	0.097	0.000	0.000	0.000
	White	0.061	0.240	0.065	0.246	0.004	0.015	0.557
	Gender	0.528	0.499	0.543	0.498	0.015	0.030	1.112
	City	0.540	0.498	0.528	0.499	-0.012	0.025	0.922
	Rural	0.095	0.293	0.101	0.302	0.006	0.021	0.773
	Suburb	0.211	0.408	0.218	0.413	0.008	0.019	0.692
	Town	0.154	0.361	0.153	0.360	-0.002	0.004	0.150
	Disability	0.174	0.379	0.185	0.388	0.011	0.029	1.057
	Low SES	0.755	0.430	0.733	0.442	-0.022	0.051	1.891
	Multiplication Table	0.060	0.238	0.061	0.240	0.002	0.006	0.227
	Separate Setting	0.276	0.447	0.285	0.451	0.009	0.020	0.753
	Text-to-speech	0.517	0.500	0.518	0.500	0.001	0.002	0.081
	ELA Score	519.735	33.670	519.809	33.176	0.074	0.002	0.081
	Math Score	519.624	43.914	519.494	44.532	-0.131	0.003	0.109

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 5 Low SES (N=17820)								
	Asian	0.043	0.202	0.044	0.206	0.001	0.007	0.649
	Black	0.121	0.326	0.123	0.328	0.002	0.006	0.535
	Hispanic	0.208	0.406	0.208	0.406	0.000	0.001	0.052
	Multi-race	0.065	0.247	0.065	0.247	0.000	0.001	0.107
	White	0.541	0.498	0.538	0.499	-0.003	0.006	0.595
	Gender	0.501	0.500	0.503	0.500	0.001	0.002	0.233
	City	0.354	0.478	0.357	0.479	0.003	0.006	0.598
	Rural	0.219	0.413	0.216	0.412	-0.002	0.006	0.539
	Suburb	0.210	0.407	0.210	0.408	0.000	0.000	0.013
	Town	0.217	0.412	0.216	0.412	-0.001	0.002	0.167
	Disability	0.184	0.388	0.185	0.389	0.001	0.002	0.205
	ELL	0.112	0.315	0.113	0.316	0.001	0.003	0.235
	Multiplication Table	0.063	0.242	0.062	0.241	-0.001	0.003	0.241
	Separate Setting	0.180	0.384	0.183	0.387	0.003	0.008	0.728
	Text-to-speech	0.252	0.434	0.257	0.437	0.004	0.010	0.900
	ELA Score	541.726	42.164	541.997	42.381	0.271	0.006	0.605
	Math Score	540.583	48.619	540.894	50.076	0.311	0.006	0.594
Math Grade 6 Disability (N=6006)								
	Asian	0.027	0.162	0.026	0.160	-0.001	0.003	0.170
	Black	0.093	0.291	0.093	0.291	0.000	0.000	0.000
	Hispanic	0.128	0.335	0.128	0.334	-0.001	0.002	0.109
	Multi-race	0.052	0.223	0.055	0.228	0.003	0.012	0.688
	White	0.680	0.467	0.678	0.467	-0.002	0.003	0.176
	Gender	0.670	0.470	0.659	0.474	-0.012	0.024	1.334
	City	0.272	0.445	0.269	0.444	-0.003	0.006	0.349
	Rural	0.222	0.416	0.225	0.418	0.003	0.007	0.350
	Suburb	0.267	0.443	0.273	0.445	0.006	0.012	0.678
	Town	0.238	0.426	0.232	0.422	-0.005	0.013	0.689
	ELL	0.077	0.266	0.076	0.265	-0.001	0.005	0.241
	Low SES	0.547	0.498	0.518	0.500	-0.029	0.058	3.164
	Multiplication Table	0.315	0.464	0.313	0.464	-0.002	0.004	0.216
	Separate Setting	0.778	0.416	0.778	0.415	0.000	0.001	0.044
	Text-to-speech	0.665	0.472	0.669	0.471	0.004	0.009	0.503
	ELA Score	542.543	45.318	541.443	44.882	-1.101	0.024	1.337
	Math Score	535.622	54.424	535.749	54.414	0.127	0.002	0.128

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 6 ELL (N=2279)								
	Asian	0.214	0.410	0.216	0.411	0.002	0.005	0.180
	Black	0.026	0.160	0.029	0.166	0.002	0.014	0.454
	Hispanic	0.693	0.461	0.685	0.465	-0.008	0.018	0.608
	Multi-race	0.008	0.091	0.009	0.093	0.000	0.004	0.161
	White	0.057	0.232	0.061	0.239	0.004	0.015	0.504
	Gender	0.554	0.497	0.553	0.497	-0.001	0.003	0.089
	City	0.548	0.498	0.535	0.499	-0.014	0.027	0.922
	Rural	0.097	0.297	0.110	0.313	0.012	0.040	1.361
	Suburb	0.198	0.399	0.198	0.398	0.000	0.001	0.037
	Town	0.156	0.363	0.158	0.364	0.002	0.005	0.163
	Disability	0.197	0.398	0.195	0.396	-0.003	0.007	0.224
	Low SES	0.783	0.412	0.747	0.435	-0.036	0.085	2.864
	Multiplication Table	0.080	0.271	0.077	0.267	-0.003	0.010	0.330
	Separate Setting	0.259	0.438	0.254	0.436	-0.005	0.011	0.373
	Text-to-speech	0.449	0.497	0.441	0.497	-0.008	0.016	0.536
	ELA Score	538.748	33.521	538.890	32.987	0.142	0.004	0.144
	Math Score	535.342	43.950	535.671	44.538	0.329	0.007	0.251
Math Grade 6 Low SES (N=17703)								
	Asian	0.051	0.221	0.052	0.221	0.000	0.001	0.096
	Black	0.117	0.322	0.117	0.322	0.000	0.001	0.050
	Hispanic	0.210	0.407	0.211	0.408	0.001	0.003	0.261
	Multi-race	0.066	0.248	0.065	0.247	-0.001	0.002	0.215
	White	0.536	0.499	0.535	0.499	-0.001	0.001	0.085
	Gender	0.511	0.500	0.512	0.500	0.001	0.001	0.117
	City	0.350	0.477	0.346	0.476	-0.004	0.008	0.703
	Rural	0.215	0.411	0.217	0.412	0.003	0.006	0.594
	Suburb	0.213	0.409	0.214	0.410	0.001	0.002	0.221
	Town	0.223	0.416	0.223	0.416	0.000	0.000	0.000
	Disability	0.177	0.382	0.176	0.381	-0.002	0.005	0.432
	ELL	0.096	0.295	0.096	0.295	0.000	0.000	0.018
	Multiplication Table	0.066	0.249	0.066	0.248	0.000	0.001	0.107
	Separate Setting	0.168	0.374	0.165	0.371	-0.003	0.008	0.727
	Text-to-speech	0.203	0.402	0.203	0.403	0.000	0.001	0.053
	ELA Score	568.136	46.332	567.601	46.504	-0.535	0.012	1.084
	Math Score	562.709	47.551	562.547	48.703	-0.163	0.003	0.318

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 7 Disability (N=5732)								
	Asian	0.023	0.151	0.023	0.150	0.000	0.002	0.124
	Black	0.094	0.292	0.096	0.294	0.002	0.006	0.319
	Hispanic	0.144	0.351	0.140	0.347	-0.005	0.013	0.696
	Multi-race	0.052	0.223	0.054	0.226	0.002	0.008	0.416
	White	0.669	0.470	0.671	0.470	0.002	0.005	0.238
	Gender	0.676	0.468	0.682	0.466	0.006	0.013	0.700
	City	0.293	0.455	0.278	0.448	-0.015	0.033	1.757
	Rural	0.217	0.412	0.220	0.414	0.004	0.009	0.452
	Suburb	0.267	0.443	0.272	0.445	0.005	0.011	0.568
	Town	0.222	0.416	0.228	0.420	0.006	0.015	0.805
	ELL	0.084	0.278	0.084	0.278	0.000	0.000	0.000
	Low SES	0.564	0.496	0.536	0.499	-0.028	0.057	3.060
	Multiplication Table	0.317	0.465	0.314	0.464	-0.003	0.007	0.382
	Separate Setting	0.778	0.416	0.784	0.411	0.007	0.016	0.836
	Text-to-speech	0.656	0.475	0.659	0.474	0.004	0.007	0.394
	ELA Score	552.382	43.462	551.920	42.422	-0.461	0.011	0.575
	Math Score	555.678	56.341	555.557	59.414	-0.121	0.002	0.112
Math Grade 7 ELL (N=2231)								
	Asian	0.222	0.416	0.216	0.412	-0.006	0.014	0.470
	Black	0.028	0.164	0.029	0.168	0.001	0.008	0.270
	Hispanic	0.692	0.462	0.688	0.463	-0.004	0.009	0.291
	Multi-race	0.006	0.076	0.007	0.082	0.001	0.011	0.379
	White	0.051	0.220	0.059	0.236	0.008	0.036	1.181
	Gender	0.554	0.497	0.561	0.496	0.006	0.013	0.422
	City	0.589	0.492	0.552	0.497	-0.038	0.076	2.541
	Rural	0.090	0.286	0.099	0.298	0.009	0.029	0.973
	Suburb	0.180	0.384	0.194	0.395	0.014	0.036	1.190
	Town	0.140	0.347	0.156	0.362	0.015	0.043	1.434
	Disability	0.202	0.402	0.205	0.404	0.003	0.007	0.223
	Low SES	0.797	0.402	0.752	0.432	-0.045	0.109	3.620**
	Multiplication Table	0.079	0.270	0.082	0.275	0.004	0.013	0.440
	Separate Setting	0.267	0.442	0.271	0.444	0.004	0.009	0.304
	Text-to-speech	0.445	0.497	0.448	0.497	0.003	0.006	0.211
	ELA Score	552.380	32.676	552.187	31.758	-0.192	0.006	0.199
	Math Score	558.598	47.726	559.100	49.403	0.501	0.010	0.345

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 7 Low SES (N=17715)								
	Asian	0.050	0.218	0.049	0.215	-0.001	0.006	0.564
	Black	0.120	0.325	0.120	0.325	0.000	0.001	0.098
	Hispanic	0.216	0.411	0.207	0.405	-0.008	0.020	1.899
	Multi-race	0.060	0.238	0.060	0.237	0.000	0.000	0.045
	White	0.534	0.499	0.544	0.498	0.010	0.021	1.950
	Gender	0.512	0.500	0.515	0.500	0.002	0.005	0.457
	City	0.358	0.479	0.346	0.476	-0.012	0.025	2.381
	Rural	0.215	0.411	0.220	0.414	0.005	0.013	1.210
	Suburb	0.208	0.406	0.214	0.410	0.005	0.013	1.211
	Town	0.219	0.414	0.220	0.415	0.002	0.004	0.347
	Disability	0.180	0.384	0.174	0.379	-0.007	0.017	1.602
	ELL	0.102	0.303	0.096	0.295	-0.006	0.021	1.972
	Multiplication Table	0.067	0.249	0.062	0.242	-0.004	0.017	1.623
	Separate Setting	0.173	0.378	0.166	0.372	-0.008	0.020	1.884
	Text-to-speech	0.197	0.398	0.191	0.393	-0.006	0.016	1.518
	ELA Score	580.613	44.480	580.593	44.119	-0.020	0.000	0.042
	Math Score	584.365	50.341	586.879	51.353	2.514	0.049	4.652***
Math Grade 8 Disability (N=5940)								
	Asian	0.024	0.153	0.023	0.151	-0.001	0.005	0.241
	Black	0.107	0.309	0.102	0.302	-0.005	0.017	0.901
	Hispanic	0.140	0.347	0.134	0.341	-0.006	0.019	1.013
	Multi-race	0.043	0.204	0.048	0.213	0.004	0.020	1.100
	White	0.663	0.473	0.673	0.469	0.009	0.020	1.091
	Gender	0.675	0.469	0.684	0.465	0.009	0.020	1.061
	City	0.298	0.458	0.270	0.444	-0.029	0.064	3.500
	Rural	0.222	0.416	0.233	0.423	0.011	0.027	1.488
	Suburb	0.253	0.435	0.253	0.435	0.000	0.001	0.042
	Town	0.226	0.418	0.243	0.429	0.017	0.040	2.186
	ELL	0.083	0.275	0.082	0.274	-0.001	0.003	0.167
	Low SES	0.558	0.497	0.528	0.499	-0.030	0.060	3.260
	Multiplication Table	0.292	0.455	0.285	0.452	-0.006	0.014	0.770
	Separate Setting	0.781	0.414	0.796	0.403	0.016	0.038	2.067
	Text-to-speech	0.652	0.476	0.665	0.472	0.013	0.028	1.509
	ELA Score	561.840	43.844	558.860	43.826	-2.980	0.068	3.705**
	Math Score	557.570	57.555	557.020	58.604	-0.550	0.010	0.516

Table 12. Covariate Representation for Matched Samples by Subject, Grade, and Subgroup (continued).

Subject & Subgroup	Covariate	Control		Treatment		Mean Diff.	D	Z/t
		Mean	SD	Mean	SD			
Math Grade 8 ELL (N=2097)								
	Asian	0.211	0.408	0.218	0.413	0.007	0.016	0.527
	Black	0.031	0.173	0.031	0.173	0.000	0.000	0.000
	Hispanic	0.705	0.456	0.691	0.462	-0.014	0.030	0.976
	Multi-race	0.006	0.078	0.007	0.081	0.001	0.006	0.193
	White	0.046	0.209	0.053	0.224	0.007	0.033	1.069
	Gender	0.569	0.495	0.573	0.495	0.004	0.009	0.281
	City	0.579	0.494	0.542	0.498	-0.037	0.075	2.427
	Rural	0.085	0.279	0.098	0.298	0.013	0.045	1.444
	Suburb	0.198	0.399	0.208	0.406	0.010	0.025	0.806
	Town	0.137	0.344	0.152	0.359	0.014	0.041	1.318
	Disability	0.214	0.410	0.214	0.410	0.000	0.000	0.000
	Low SES	0.805	0.396	0.751	0.433	-0.054	0.131	4.234***
	Multiplication Table	0.080	0.271	0.083	0.276	0.003	0.012	0.396
	Separate Setting	0.268	0.443	0.276	0.447	0.007	0.016	0.521
	Text-to-speech	0.437	0.496	0.443	0.497	0.006	0.013	0.404
	ELA Score	563.448	35.878	563.739	35.774	0.291	0.008	0.263
	Math Score	561.406	48.158	562.946	48.736	1.540	0.032	1.029
Math Grade 8 Low SES (N=17459)								
	Asian	0.049	0.216	0.048	0.214	-0.001	0.004	0.374
	Black	0.126	0.332	0.125	0.331	-0.001	0.002	0.210
	Hispanic	0.208	0.406	0.204	0.403	-0.004	0.009	0.847
	Multi-race	0.056	0.230	0.059	0.235	0.003	0.012	1.083
	White	0.539	0.498	0.541	0.498	0.002	0.004	0.387
	Gender	0.519	0.500	0.519	0.500	0.000	0.000	0.011
	City	0.351	0.477	0.340	0.474	-0.011	0.023	2.172
	Rural	0.220	0.414	0.225	0.417	0.005	0.012	1.145
	Suburb	0.208	0.406	0.204	0.403	-0.004	0.009	0.807
	Town	0.222	0.415	0.231	0.422	0.010	0.023	2.135
	Disability	0.181	0.385	0.180	0.384	-0.002	0.004	0.362
	ELL	0.095	0.293	0.094	0.292	-0.001	0.003	0.257
	Multiplication Table	0.060	0.237	0.059	0.236	0.000	0.001	0.113
	Separate Setting	0.171	0.376	0.169	0.375	-0.002	0.004	0.399
	Text-to-speech	0.185	0.388	0.184	0.387	-0.001	0.003	0.317
	ELA Score	592.859	46.745	591.765	47.031	-1.094	0.023	2.179
	Math Score	592.942	54.211	593.679	54.717	0.737	0.014	1.264

Note. N represents size per group.

** p < .05*

*** p < .01*

**** p < .001*