A Study of the Efficacy of Apex Learning Adaptive Tutorials on Middle School Student Achievement Year 1

Beaverton School District, OR

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Introduction

Beaverton School District (BSD), the third-largest school district in Oregon, serves approximately 40,000 students in 51 schools. In the 2014-2015 school year, the district adopted Apex Learning Adaptive Tutorials to personalize learning and enhance classroom instruction in secondary schools.

Adaptive Tutorials provide instruction, practice, review, and assessment of skills aligned to state standards in English language arts, mathematics, science, and social studies. The web-based program is designed to be used flexibly to enhance or remediate specific skills through the delivery of modules grouped into units. Tutorials can be used by individual students, in small group settings, and by classroom or grade level. Students may complete a formative unit pretest which generates a prescriptive learning plan indicating which modules a student should complete. After demonstrating mastery of all unit modules students may complete a summative unit post-test. Real-time data allow teachers to monitor student progress by module, unit, and standard at the individual and classroom level.

During the 2014-2015 school year, seventh and eighth grade students from two BSD middle schools used English and math Tutorials as a supplement to traditional classroom instruction. Teachers implemented Tutorials in ways that best suited their instructional goals, student needs, and available technological resources. Students completed Tutorials in the school computer lab, from classroom laptop computers, and from home. In the spring, students completed the Smarter Balanced Assessment Consortium (SBAC) computer adaptive summative assessments administered by the Oregon Department of Education. The grade level summative assessments measure student mastery of the state standards in English language arts and mathematics.

This study examined the relationship between Apex Learning Adaptive Tutorials use and performance on the SBAC computer adaptive summative assessments for English language arts and mathematics. Students included in the analytic sample participated in traditional instruction offered through the district regular education program. Students in the Tutorials group used English or math Tutorials for one hour or more during the 2014-2015 school year in addition to traditional classroom instruction. Students in the comparison group participated in traditional instruction and did not use Tutorials.

2014-2015 District Demographic Characteristics

District PK-12 Enrollment	39,763
Urban Locale	Small City
American Indian/AK Native	0%
Asian	14%
Black /African American	3%
HI/Pacific Islander	1%
White	50%
Hispanic	25%
Multiracial	7%
Free/Reduced Meals	33%
Limited English Proficient	13%
Students with Disabilities	12%

Source: https://www.beaverton.k12.or.us/about-us/Pages/quick-facts.aspx

The comparison group of students were randomly selected from the same schools and matched the Tutorials group by demographic characteristics and prior ability. The achievement of students using Tutorials as a supplement to traditional classroom instruction was compared to the achievement of similar students enrolled in the same schools who did not use Tutorials.

The study included 289 students using 301 Tutorials enrollments. BSD students using Apex Learning Adaptive Tutorials:

- Had an average pretest ability in relation to district norms equivalent to the 61th percentile in English an 77th percentile in math
- Were mostly white (58%)
- Participated in the regular education program (96%)

Located in the appendix, Table 1 provides detailed demographic and prior ability characteristics of studentsusing Apex Learning Adaptive Tutorials and students included in the comparison group. Table 2, also located in the appendix, shows the average Tutorials usage statistics for students included in the analytic sample.

Results

Do middle school students using Apex Learning Adaptive Tutorials have the same or better chances of meeting or exceeding the state standards (Level 3 or above) on the SBAC summative assessments as similar students not using Adaptive Tutorials?

Overall, students using Adaptive Tutorials were 13% more likely (.88 / .78) to meet or exceed the state standard on the SBAC assessments than students participating in classroom instruction alone (OR=2.06, p<.03, ES=.44). By subject, students using Tutorials were 20% more likely (.88 / .73) to meet or exceed the state standard for English language arts (OR=2.73, p<.03, ES=.61) and 6% more likely (.87 / .82) for mathematics (OR=1.48, p<.10, ES=.24) than similar students participating in traditional classroom instruction alone. Table 3 in the appendix shows the number of enrollments in each group meeting or exceeding the standard and Table 4 shows the probability, odds, and risk ratio for meeting or exceeding the state standards by Tutorials use on the assessments overall and by subject.

Figure 1 shows the percent of students meeting or exceeding the standard by Adaptive Tutorials use and subject. The percent of students meeting or exceeding the standard on assessments overall was 10 percentage points greater (.88 - .78) for those using Tutorials than similar students not using Tutorials (z=3.29, p<.00). By subject, the percent of students meeting or exceeding the standard on the English language arts assessments was 15 percentage points greater (.88 - .73) for students using Tutorials than students not using Tutorials (z=2.95, p<.00). The difference between the percent of students meeting or exceeding the standard for mathematics trended higher (.87 -. 82) for students using Tutorials than for students not using Tutorials and approached statistical significance (z=1.30, p<.10).

Figure 1

Estimated percent of students meeting or exceeding state standards by subject and Adaptive Tutorials use
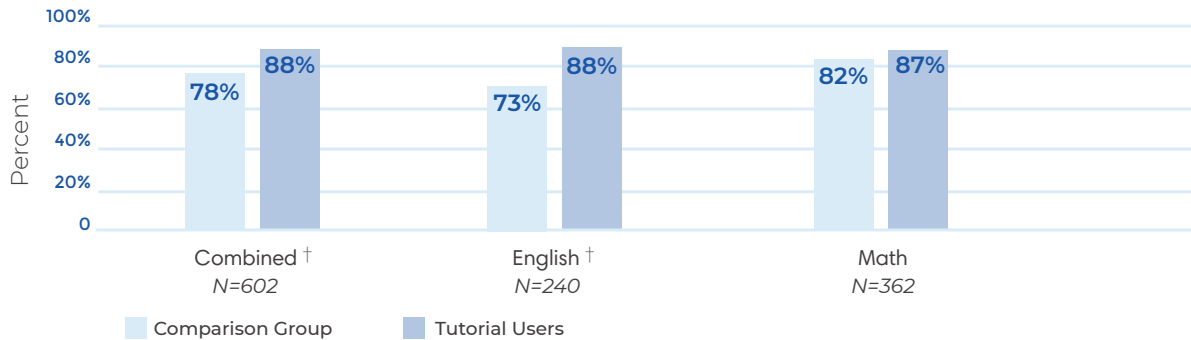
† Statistically significant p<.05.
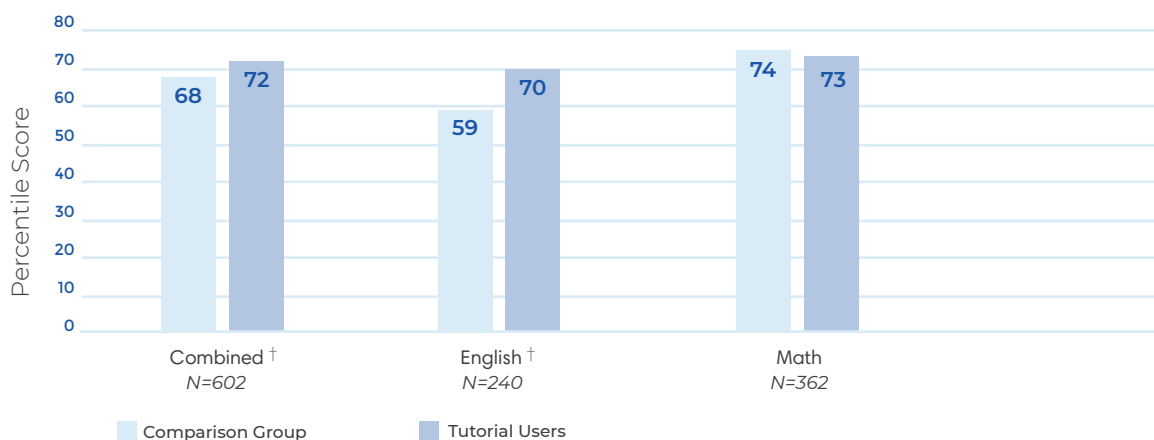Percent of students adjusted for differences in prior ability and demographic characteristics.

Do middle school students using Apex Learning Adaptive Tutorials perform the same or better on SBAC summative assessments as similar students not using Adaptive Tutorials?

Overall, the average student using Adaptive Tutorials in addition to classroom instruction (M=.61, SD=.65) performed significantly better on the SBAC summative assessment than the average student participating in traditional classroom instruction alone (M=.49, SD=.94) (t(601)=2.99, p<.00, ES=.12).

Figure 2 shows the average equivalent percentile score for students using Tutorials and similar students participating in traditional classroom instruction alone. Students using Tutorials achieved an additional 4 percentile points on the SBAC summative assessments combined and an additional 11 percentile points on the English language arts assessments compared to similar students (t(601)=4.15, p<.00, ES=.30). Students using Tutorials for math achieved similar average scores on the mathematics assessments as students participating in traditional classroom instruction alone.

Figure 2

Estimated average SBAC summative assessment equivalent percentile score by subject and Adaptive Tutorials use

† Statistically significant p<.05.
Percentile score adjusted for differences in prior ability and demographic characteristics.

Conclusion

Middle school students using Apex Learning Adaptive Tutorials in addition to traditional classroom instruction demonstrated significant gains on the SBAC summative assessments compared to similar students participating in traditional classroom instruction alone. Tutorials users were 13% more likely to meet or exceed the state standards than students not using Tutorials overall and 20% more likely to meet or exceed the standard for English language arts. The difference between the percent of students meeting or exceeding state standards overall and for English language arts was significantly greater for students using Tutorials than for similar students not using Tutorials, and for mathematics trended higher for students using Tutorials compared to students participating in traditional instruction alone. Additionally, the average Tutorials user gained 4 percentile points overall and 11 percentile points on the English language arts SBAC summative assessments compared to similar students not using Tutorials.

Study Description

Study Design

A quasi-experimental group design was used to study the impact of Apex Learning Adaptive Tutorials use on English language arts and mathematics performance on SBAC computer adaptive summative assessments. Teachers used Tutorials in ways that best suited their instructional goals, individual student needs, and available technological resources. Students using Tutorials completed modules in addition to traditional classroom instruction. Students in the comparison group participated in traditional classroom instruction alone.

Participants

Students included in the study were enrolled in seventh and eighth grade and completed at least one subject-area SBAC summative assessment during the 2014-2015 school year and an Oregon Assessment of Knowledge and Skills (OAKS) end-of-year exam from the prior grade level. Table 2 in the appendix shows the demographic and prior ability characteristics of students in the Tutorials and comparison groups.

Data Preparation

BSD provided student level data for 18,903 students enrolled in grades 7-12 during the 2014-2015 school year. The data included district id numbers, demographic characteristics, and assessment scores. Demographic data elements included: school, date of birth, grade, gender, race, and indicators identifying English langage learners and special education participants. The district also provided results from two state assessments. Results from the Smarter Balanced Assessment Consortium summative assessments administered during the 2014-2015 school year were provided as an outcome measure. Scores from the Oregon Assessment of Knowledge and Skills tests administered between the 2009-2010 and 2013-2014 school years were provided as a measure of prior ability. Scaled scores were transformed into standardized z-scores, calculated by year and subject, to allow test results to be combined and analyzed across assessments.

Apex Learning provided a file containing 543 Tutorials enrollments that were used during the 2014-2015 school year. The file included school name, product name, classroom name, number and percent of Tutorials modules completed, total session minutes, and quality of work score. Tutorials enrollment records were joined to the demographic and assessment files. A total of 401 enrollments had matching demographic, prior ability and SBAC end-of-year assessment records and had begun using Tutorials prior to the SBAC administration date. A total of 301 enrollments used Tutorials for 60 minutes for more during the 2014-2015 school year.

For each assessment, propensity score analysis and case-control matching was used to generate a random sample of students with similar prior ability and demographic characteristics as students using Tutorials. The model used to create the propensity score included the following variables: prior ability, age at time of SBAC testing, gender, minority status, limited English proficiency, special education program participation, grade level, and school. The population of students included in the comparison group sampling frame were enrolled in the same schools as students using Tutorials and did not use Apex Learning Courses or Tutorials during the 2014-2015 school year.

Analysis

A linear mixed model was used to compare the average achievement of students using Tutorials to the comparison group of students not using Tutorials. School was fitted as a random effect to control for school level factors that could impact the outcome measure. Pretest ability, minority status, gender, special education program participation, limited English proficiency, and grade level were treated as covariates. Hedge's g was calculated to estimate the effect size of the intervention. The covariate adjusted mean difference between groups was divided by the unadjusted pooled standard deviation. The covariate adjusted mean z-scores for the comparison and Tutorials user groups were reported in percentile scores normed on the district population of test takers.

Logistic regression was used to predict the odds of achieving a Level 3 or above on the SBAC summative assessment by Tutorials use. Pretest ability, race/ethnicity, gender, special education program participation, limited English proficiency, and grade level were treated as covariates. The Cox index was calculated to estimate the effect size of the intervention by dividing the log odds ratio by 1.65. A covariate-adjusted version of the original 2 X 2 table was constructed to estimate the number of students meeting or exceeding a Level 3 when demographic characteristics and prior ability differences between groups are controlled.

The covariate-adjusted estimates were reported in terms of the percentage of students meeting or exceeding the standards. A z-ratio was calculated to assess the significance of the difference between the proportion of students meeting or exceeding the standards by Tutorials use.

Outcome Measures

Findings for the study are based on the 2014-2015 SBAC computer adaptive summative assessments in English language arts and mathematics. The SBAC summative assessments measure student mastery of the Common Core Standards. Scale scores ranging from 2,000 to 3,000 and achievement levels 1 through 4 are reported for each subject area test. Achievement levels describe the knowledge and skills students demonstrate on a given test. Oregon set Level 3 as meeting the standard and Level 4 as exceeding the standard across grades and subjects.

The Oregon Department of Education administered the SBAC summative assessments for English language arts and mathematics in the spring of 2015 to students in third through eighth grades and in eleventh grade.

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Appendix

Table 1: Demographic Characteristics and academic achievement by Adaptive Tutorials use					
	Comparison Group		Adaptive Tutorials Group		Total
Demographic Characteristics	N	Percent	N	Percent	N
Total Enrollments	301	100.00%	301	100.00%	602
7th Grade	140	50.00%	140	50.00%	280
8th Grade	161	50.00%	161	50.00%	322
Female	142	48.30%	152	51.70%	294
Male	159	51.60%	149	48.40%	308
Asian	100	54.90%	82	45.10%	182
Black/African American	0	0.00%	3	100.00%	3
Hispanic/Latino	24	57.10%	18	42.90%	42
Two or more races	11	31.40%	24	68.60%	35
White	166	48.80%	174	51.20%	340
Limited English Proficiency – Y	2	66.70%	1	33.30%	3
Special Education Program - Y	28	68.30%	13	31.70%	41
Prior Ability Standardized Z-Scores	Mean	StdDev	N	Mean	StdDev	N	N
OAKS Combined	0.46	1.03	301	0.57	0.70	301	602
OAKS Reading	0.26	1.08	120	030	0.73	120	240
OAKS Mathematics	0.59	0.98	181	0.75	0.61	181	362
End-of-Year Standardized Z-Scores	Mean †	StdDev	N	Mean †	StdDev	N	N
SBAC Total Combined	0.49	0.94	301	0.61	0.65	301	602
SBAC English Language Arts Combined	0.25	0.97	120	0.54	0.79	120	240
SBAC Mathematics Combined	0.65	0.89	181	0.64	0.54	181	362
End-of-Year Standardized Z-Scores	Mean †	StdDev	N	Mean †	StdDev	N	N
SBAC English 7	2616.26	111.47	39	2614.69	71.90	39	78
SBAC English 8	2629.05	90.95	81	2670.49	82.43	81	162
SBAC Math 7	2658.44	106.77	101	2658.50	52.27	101	202
SBAC Math 8	2693.43	111.08	80	2690.36	79.00	80	160

† Means adjusted for prior ability, minority status, gender, special education program participation, and English language learner. Standard deviations are unadjusted.

Table 2: Average Adaptive Tutorials usage statistics by subject, assessment, and product

		Enrollments	Modules Attempted	Progress Completed	Number of Days Between First and Last Use	Total Session Hours	Quality of Work
		N	Median	Median	Median	Median	Median
Subject	English	120	5	14.29	84	2.68	67
	Math	181	9	21.82	58	5.22	70
SBAC Assessment	English 7	39	6	16.22	1	1.63	72
	English 8	81	4	11.43	85	3.17	65
	Math 7	101	15	50.00	58	6.43	75
	Math 8	80	4	8.18	98	2.46	60
Tutorials Product	English 7	39	6	16.22	1	1.63	72
	English 8	81	4	11.43	85	3.17	65
	Math 7	99	15	50.00	58	6.48	75
	Math 8	27	1	3.45	38	1.55	46
	Algebra I	55	6	10.91	98	2.83	64
Total		301	6	16.36	58	3.37	69

Table 3: Adjusted number of Adaptive Tutorials enrollments meeting or exceeding state standards

Subject	Groups	Met or Exceeded		Total
		No	Yes	
All	Control Group	65	236	301
	Tutorials Users	35	266	301
	Total	100	502	602
English	Control Group	32	88	120
	Tutorials Users	14	106	120
	Total	46	194	240
Math	Control Group	33	148	181
	Tutorials Users	24	157	181
	Total	46	316	362

† Statistically significant p<.05.
Tutorials user group data adjusted for differences in prior ability and demographic characteristics.

Table 4: Adjusted probability, odds, and risk ratio for meeting state standards by Adaptive Tutorials use							
Subject	Meet or Exceed Standard	Group		Percentage Point Difference	Ratio of Larger to Smaller		sig.
		Control	Tutorials				
All	Yes	0.78	0.88	0.10	1.13	Risk Ratio	
	No	0.22	0.12	0.10	1.86	Risk Ratio	
	Odds	3.63	7.60	.	2.09	OR	0.00
English	Yes	0.73	0.88	0.15	1.20	Risk Ratio	
	No	0.27	0.12	0.15	2.29	Risk Ratio	
	Odds	2.75	7.57	.	2.75	OR	0.00
Math	Yes	0.82	0.87	0.05	1.06	Risk Ratio	
	No	0.18	0.13	0.05	1.38	Risk Ratio	
	Odds	4.48	6.54	.	1.46	OR	0.00

Subject		Coefficient B	Std. Error	Wald	df	Sig.	Odds Ratio Exp(B)	Effect Size
Table 5: Logistic regression coefficients for estimating the odds ratio for meeting or exceeding state standards								
Combined	Prior Ability	2.765	0.330	70.019	1	0.00	15.87	
	Minority	0.063	0.321	0.039	1	0.84	1.07	
	Male	-0.539	0.316	2.914	1	0.09	0.58	
	SPED	-1.525	0.514	8.819	1	0.00	0.22	
	ELL	-1.334	7.429	0.032	1	0.86	0.26	
	Grade	-0.46	0.419	1.209	1	0.27	0.63	
	SBAC Subject	.	.	4.296	2	0.12	.	
	SBAC Subject (1)	0.184	0.528	0.122	1	0.73	1.20	
	SBAC Subject (2)	0.849	0.413	4.237	1	0.04	2.34	
	Tutorials Use	0.721	0.324	4.967	1	0.03 †	2.06	0.44
	Constant	4.789	3.143	2.322	1	0.13	120.17	
English	Prior Ability	2.386	0.449	28.264	1	0.00	10.87	
	Minority	0.698	0.496	1.979	1	0.16	2.01	
	Male	-0.669	0.470	2.030	1	0.15	0.51	
	SPED	-1.326	0.571	5.388	1	0.02	0.27	
	ELL	-16.028	40192.970	0.000	1	1.00	0.00	
	Grade	0.221	0.494	0.200	1	0.66	1.25	
	Tutorials Use	1.005	0.462	4.731	1	0.03 †	2.73	0.61
	Constant	-0.193	3.811	0.003	1	0.96	0.82	
Math	Prior Ability	3.345	0.517	41.863	1	0.00	28.37	
	Minority	-0.472	0.442	1.141	1	0.29	0.62	
	Male	-0.645	0.450	2.053	1	0.15	0.53	
	SPED	-2.071	1.235	2.813	1	0.09	0.13	
	ELL	-0.942	11.261	0.007	1	0.93	0.39	
	Grade	-0.413	0.450	0.844	1	0.36	0.66	
	Tutorials Use	0.391	0.462	0.718	1	0.40	1.48	0.24
	Constant	4.861	3.365	2.087	1	0.15	129.12	

† Statistically significant difference.
Effect size reported as the size of the impact attributed to Tutorials use when prior ability and demographic characteristics

Table 6. ANCOVA linear mixed model coefficients for estimating SBAC standardized z-scores								
						95% Confidence Interval		
Subject	Parameter	B	Std. Error	t	sig.	Lower Bound	Upper Bound	Effect Size
Combined	Prior Ability	2.765	0.330	70.019	1	0.00	15.87	
	Minority	0.063	0.321	0.039	1	0.84	1.07	
	Male	-0.539	0.316	2.914	1	0.09	0.58	
	SPED	-1.525	0.514	8.819	1	0.00	0.22	
	ELL	-1.334	7.429	0.032	1	0.86	0.26	
	Grade	-0.46	0.419	1.209	1	0.27	0.63	
	SBAC Subject	.	.	4.296	2	0.12	.	
	SBAC Subject (1)	0.184	0.528	0.122	1	0.73	1.20	
	SBAC Subject (2)	0.849	0.413	4.237	1	0.04	2.34	
	Tutorials Use	0.721	0.324	4.967	1	0.03 †	2.06	0.44
	Constant	4.789	3.143	2.322	1	0.13	120.17	
English	Prior Ability	2.386	0.449	28.264	1	0.00	10.87	
	Minority	0.698	0.496	1.979	1	0.16	2.01	
	Male	-0.669	0.470	2.030	1	0.15	0.51	
	SPED	-1.326	0.571	5.388	1	0.02	0.27	
	ELL	-16.028	40192.970	0.000	1	1.00	0.00	
	Grade	0.221	0.494	0.200	1	0.66	1.25	
	Tutorials Use	1.005	0.462	4.731	1	0.03 †	2.73	0.61
	Constant	-0.193	3.811	0.003	1	0.96	0.82	
Math	Prior Ability	3.345	0.517	41.863	1	0.00	28.37	
	Minority	-0.472	0.442	1.141	1	0.29	0.62	
	Male	-0.645	0.450	2.053	1	0.15	0.53	
	SPED	-2.071	1.235	2.813	1	0.09	0.13	
	ELL	-0.942	11.261	0.007	1	0.93	0.39	
	Grade	-0.413	0.450	0.844	1	0.36	0.66	
	Tutorials Use	0.391	0.462	0.718	1	0.40	1.48	0.24
	Constant	4.861	3.365	2.087	1	0.15	129.12	

a This parameter is set to zero because it is redundant.
† Statistically significant difference.
Effect size reported as the size of the impact attributed to Tutorials use when prior ability and demographic characteristics are statistically controlled.

Table 7. ANCOVA linear mixed model coefficients for estimating SBAC scale scores

Subject	Parameter	B	Std. Error	t	sig.	95% Confidence Interval Lower Bound	Upper Bound	Effect Size
English 7	Intercept	2601.81	10.78	241.47	0.00	2580.33	2623.29	
	Prior Ability	59.46	6.60	9.01	0.00	46.30	72.61	
	Minority	24.50	11.30	2.17	0.03	1.97	47.04	
	Male	-6.26	11.61	-0.54	0.59	-29.39	16.88	
	SPED	-92.68	20.39	-4.55	0.00	-133.32	-52.04	
	ELL	.	.	.	.	.	.	
	[Control Group]	1.58	11.32	0.14	0.89	-20.99	24.14	
	[Tutorials Group]	0a	.	.	.	.	.	-0.02
English 8	Intercept	2655.41	8.86	299.83	0.00	2637.91	2672.90	
	Prior Ability	66.65	5.42	12.29	0.00	55.94	77.37	
	Minority	11.62	9.20	1.26	0.21	-6.55	29.78	
	Male	-7.59	8.92	-0.85	0.40	-25.21	10.04	
	SPED	-34.07	14.99	-2.27	0.02	-63.67	-4.46	
	ELL	-22.67	58.91	-0.39	0.70	-139.03	93.69	
	[Control Group]	-41.45	8.82	-4.70	0.00 †	0.00 †	-24.02	
	[Tutorials Group]	0a	.	.	.	.	.	0.48
Math 7	Intercept	2607.24	7.16	363.93	0.00	2593.12	2621.37	
	Prior Ability	78.61	4.78	16.45	0.00	69.19	88.04	
	Minority	2.43	6.64	0.37	0.72	-10.66	15.52	
	Male	6.85	6.65	1.03	0.31	-6.27	19.96	
	SPED	-73.35	17.20	-4.27	0.00	-107.26	-39.43	
	ELL	-81.72	48.07	-1.70	0.09	-176.52	13.08	
	[Control Group]	-0.06	6.76	-0.01	0.99	-13.39	13.27	
	[Tutorials Group]	0a	.	.	.	.	.	0.00
Math 8	Intercept	2631.22	9.08	289.80	0.00	2613.28	2649.16	
	Prior Ability	90.45	5.63	16.07	0.00	79.33	101.57	
	Minority	14.03	9.18	1.53	0.13	-4.10	32.16	
	Male	-19.97	9.00	-2.22	0.03	-37.75	-2.20	
	SPED	-64.49	41.19	-1.57	0.12	-145.85	16.88	
	ELL	11.68	57.45	0.20	0.84	-101.82	125.18	
	[Control Group]	3.07	9.07	0.34	0.74	-14.84	20.99	
	[Tutorials Group]	0a	.	.	.	.	.	-0.03

a This parameter is set to zero because it is redundant.
† Statistically significant difference.
Effect size reported as the size of the impact attributed to Tutorials use when prior ability and demographic characteristics are statistically controlled.

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