



Complementary Report to “Estimating the ST Math Benefit”

Summary:

The aim of this analysis is to recreate and build upon the original analysis reported in “Estimating the ST Math Benefit” as provided by the vendor. Model misinterpretation may occur when the outcome and the predictor of interest are both correlated to a third variable (termed *confounder*), particularly in the assignment of an intervention. Additionally, we hope to improve model fit and precision, under the assumption that an increase in the proportion of variability explained by a model increases its utility.

Of the 14,159 Pinellas County 4th and 5th graders eligible for analysis, 12,882 had available data on ST Math usage. This proportion (91.0%) is very likely representative of the entire 4th and 5th grade population. In general, there appears to be a consistent dose-response relationship between ST Math usage and DSS growth. After controlling for possible confounders, ST Math usage is associated with 1.42 DSS points per 10% of completion.

Methods

Fourth and Fifth graders with ST Math usage during the 2017-18 school year and 2016-17 and 2017-18 Florida Standards Assessment (FSA) Math scores were included in this analysis; this sample of 12,882 students is the exact sample used in the original report. The outcome, change in developmental scale score (DSS) from 2016-17 to 2017-18, and modeling method, hierarchical linear modeling, are used here. However, in addition to the predictor of interest (ST Math completion rate), prior-year FSA measures (namely, achievement level and DSS) were included as fixed effects in our models. This serves two purposes: first, accounting for these factors mitigates the risk of confounding on these variables and subsequent model misinterpretation. Second, the addition of these factors accounts for much of the variability of DSS growth from year to year, which improves model fit and precision.

Results & Discussion

Descriptive Statistics of Prior-Year DSS and ST Math Usage

Table 1 reports the number of students with each combination of prior-year FSA Achievement Sublevel and current-year ST Math usage (divided into ten bins). **Table 2** reports the average change in DSS from 2016-17 to 2017-18 for each of these combinations. In general, there appears to be a consistent dose-response relationship between ST Math usage and DSS growth. To get an estimate of this effect on the average student, we will rely upon the results of our hierarchical linear model.

**Table 1:
Counts**

ST Math Completion Rate	Prior-Year FSA Achievement Sublevel								Total
	1.1	1.2	1.3	2.1	2.2	3	4	5	
0-10%	98	145	196	71	47	72	29	11	669
10-20%	81	235	347	123	113	150	60	15	1124
20-30%	76	189	405	164	134	200	96	17	1281
30-40%	47	170	340	163	141	211	95	24	1191
40-50%	25	104	309	136	122	211	106	30	1043
50-60%	20	93	301	168	147	308	143	54	1234
60-70%	19	82	272	180	188	406	174	59	1380
70-80%	7	24	162	99	102	256	137	43	830
80-90%	3	33	184	105	131	324	177	58	1015
90-100%	10	67	410	290	344	1057	674	263	3115
Total	386	1142	2926	1499	1469	3195	1691	574	12882

**Table 2:
Avg Growth**

ST Math Completion Rate	Prior Year FSA Achievement Bucket								Total
	1.1	1.2	1.3	2.1	2.2	3	4	5	
0-10%	8.7	4.5	6.8	7.7	6.1	5.1	8.2	4.5	6.5
10-20%	11.0	6.1	6.1	7.3	2.6	5.8	4.7	5.6	6.1
20-30%	12.9	7.1	7.5	6.3	4.2	5.9	3.2	-4.5	6.5
30-40%	17.0	9.1	9.1	7.7	6.7	6.0	6.0	0.2	8.0
40-50%	17.0	11.8	10.0	9.4	6.5	7.2	5.2	-2.6	8.4
50-60%	19.7	10.6	10.3	10.0	9.2	7.8	5.2	0.4	8.7
60-70%	26.5	18.0	13.1	10.2	9.0	9.0	9.0	1.6	10.4
70-80%	34.0	20.9	14.5	14.7	11.4	11.5	7.4	-2.2	11.5
80-90%	25.3	20.7	14.3	14.0	14.7	13.5	9.9	3.9	12.9
90-100%	30.2	20.8	18.4	16.1	14.2	14.1	11.8	2.4	13.6
Total	14.2	9.8	10.9	10.8	9.5	10.5	8.9	1.5	9.9

Mixed Effect Model Output, Fit, and Interpretation

The beta coefficient associated with ST Math completion was 14.27 (SE 0.46). After controlling for possible confounders, ST Math usage is associated with 1.42 DSS points per 10% of completion. Additionally, including these variables in the model increased the conditional R^2 to 0.32.

According to these findings, prior-year FSA DSS/Achievement was indeed a confounder of ST Math's estimated effect on DSS growth. However, this likely led to an underestimation of ST Math's effect; the estimate given in the original report is likely a conservative one, and projections based on this estimate are likely to be conservative as well.

