Raising the Bar District-Wide Using Symphony Math

Symphony Learning: Research Study 02 26 2020
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Abstract

Students and staff from Graves County, Kentucky, participated in a study during the 2018-19 school year to examine the effect of the Symphony Math foundational numeracy program in grades 1 through 4. In order to provide comparison, approximately half the population used Symphony Math as their sole technology intervention, while the other half participated in the standard district math curriculum, which combined different online and offline resources. As students used Symphony Math, teachers were able to monitor their progress and provide interventions when necessary using data dashboards and recommended offline materials. District policy included administration of the STAR® Math assessment to the full student population at several dates during the school year. The results from this third-party testing show that students who used Symphony Math made significant gains in math achievement and, on average, outperformed their peers in the district who did not use the program.

Introduction

A number of research studies have demonstrated that struggling math students often have an underdeveloped understanding of foundational numeracy. Graves County Schools are located in the western region of Kentucky. The student population in the district was 4,073 in 2017. The demographic makeup of the district is over 87% White (non-Hispanic), and over 57% of students qualify for free or reduced lunch. After being introduced to Symphony Math through a local company, the district began a pilot of Symphony Math in August of 2018. In October 2018 the pilot was refined to focus on early elementary students. Since several populations had not used the program, the district agreed to participate in a study by Symphony Learning designed to measure the difference in achievement between students who used Symphony Math and students who did not use the program.This report summarizes the implementation of the program and subsequent results.

Participants

Students from Graves County Schools in grades K-4 participated in the use of Symphony Math during the 2018-19 school year. Only grades 1-4 were used in this analysis due to the lack of consistent third-party testing results in the Kindergarten population. The treatment group, who used Symphony Math, came from 5 of the 7 elementary schools in grades 1 and 2, and two of the schools in grades 3 and 4. The control group, who did not use Symphony Math, was comprised of 2 elementary schools in grades 1 and 2, and 5 elementary schools in grades 3 and 4. Overall, 579 students comprised the treatment group, while 624 students were included in the control group.

Implementation

The Elementary Instructional Supervisor in Graves County received initial training and support from a qualified Symphony Math regional representative, including several on-site visits, telephone, and email support. A goal of 45 minutes of use per week for students was set. Student use was shown to be consistent throughout the school year, as is shown in Figure A.

In addition, each participating school received additional in-person training in October 2018. Each grade level team participated in a 30-minute information session that focused on data analysis and use of the program's offline materials in order to better support students as they used Symphony Math.

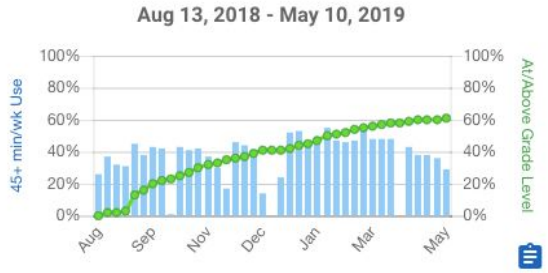


Figure A: Use of Symphony Math in Graves County

The blue bars throughout the school year show that many students used Symphony Math at least 45 minutes per week consistently throughout the school year. An average of 22.8 hours use was noted across the entire population of students. While there was variance noted between individual students and classrooms (see Appendix B), no distinction was made for the purposes of analysis in this study. If students used Symphony Math, their data was reported in the treatment group regardless of time spent on the program. This decision was made because, despite variance in use, classroom instruction and decision-making was affected by use of the program.

Intervention

Symphony Math is an intervention program designed to help students develop a profound understanding of the most important mathematical concepts. Many students struggle to become proficient in math because they do not have the opportunity to master foundational concepts with sufficient depth. In an age when most curricula value covering a large number of topics, some students are falling through the cracks. They need more time and more practice working with the big ideas of mathematics in order to develop the proper foundation.

Symphony Math provides students with the experience of learning and thinking about the most important mathematical concepts. This experience provides the necessary foundation for a successful future of math learning. Symphony Math helps students achieve this solid mathematical foundation by implementing several key research-based pedagogic strategies.

The conceptual sequence of Symphony Math consists of a tightly connected progression of the most important mathematical ideas. These underlying "big ideas" are important because they provide the foundation for later mathematical learning. A student does not move on to the next concept in the Symphony Math sequence until she has mastered the current concept. One concept follows logically from the previous concept. While a student is working on a new concept she sees review concepts that help support her learning of the new concept. This process helps the student connect new knowledge to previous knowledge.

Symphony Math uses visual models to help students formalize their understanding of foundational number sense concepts. Students construct bar models, counting dots, number lines, grids, and fraction strips in their investigation of the most important ideas in mathematics. A concrete-to-abstract approach gradually introduces symbols, and always uses models in the justification of correct solutions.

The pedagogic style of Symphony Math emphasizes thinking, figuring out, and making connections. The program is designed to be used as a complement to the classroom learning

experience. Students receive direct instruction and group learning in a classroom setting. The program provides the opportunity for individual practice at the developmental level of each student. The style of this practice encourages independent thinking and problem solving, and this is accomplished through the use of these important pedagogic strategies.

Symphony Math works with each student at his or her developmental level. The "dynamic branching" of the program and detailed progression of the scope and sequence allows students to work within their developmental zones. The amount of time and practice that students need to understand mathematical concepts is not uniform. Symphony Math allows students to spend the time they need in order to master foundational concepts. In addition, the program quickly moves students through the conceptual progression of the program to identify their area of need. Once the area of need has been identified, the program slows the progress until the necessary understanding has been achieved.

In addition to adjusting the pace of progress, Symphony Math also alerts educators of the need for intervention when students show signs of struggle. For every skill covered in the program, offline Guided Practice materials are available. Educators can use these materials to structure small group or 1:1 work sessions with students. The offline materials offer a chance for educators and students to express their understanding of difficult topics, and they are an important key to successful implementations.

Assessment

All participating students were given the STAR 360® Math assessment (STAR), by Renaissance Learning, several times during the 2018-19 school year. The assessment Growth Report provides a Scale Score (SS), Percentile Rank (PR), National Curve Equivalents (NCE), and Grade Equivalent (GE) for each student based on norm referenced scores. The multiple administrations of testing allow for comparisons in growth during the school year.

Analysis

This study compares results on the STAR assessment in grades 1 through 4 between the treatment and control groups. The assessment was administered at the beginning of the school year (August), late fall, winter, and spring (April). The results provided for this analysis were taken from the STAR Growth Report, and compared student results in the first and last administrations of the assessment.

A preliminary analysis of data compared percentile rank (PR) averages of class groupings. Though significant gains were found, it was agreed that further analysis was needed at the student-level. See Appendix B for details on this preliminary data.

Students included in this analysis needed to have at least two assessment results. There were 23 students in the population who did not meet this requirement. They are not included in this analysis.

Out of Scale Scores (SS), Grade-Equivalent (GE) scores, Percentile Ranks (PR), and Normal Curve Equivalent (NCE) scores, only NCEs were analyzed. Visual inspection of the data revealed that, for some students the STAR data report did not indicate a specific GE score. Instead the report indicated, for example, <1, >5, >6. These scores would make it hard to make specific comparisons.

An independent samples t-test revealed that the groups' (treatment and control) pre-SS scores were significantly different, $p < .001$; therefore, SS were not included in the analysis.

The pre-PR scores violated assumptions of normality and equal variance. Therefore, these scores were not directly analyzed, instead NCE scores were. NCE is a norm-referenced score similar to percentile rank but based on an equal interval scale. For the pre-NCE scores there were unequal sample sizes (control: $n = 624$; treatment:

n = 579). Furthermore, boxplots revealed that there were 2 potential outliers in the control group and 4 potential outliers in the treatment group. However, the research found it important to consider all of the students' data and did not want to remove these potential outliers.

For the control group, both Kolmogorov-Smirnov and Shapiro-Wilk tests of normality were violated, p < .001. For the treatment group, the Kolmogorov-Smirnov test was passed, p =.077, but the Shapiro-Wilk test was violated, p < .001. However, pre-NCE scores passed Levene's test for equality of variance, p =.430.

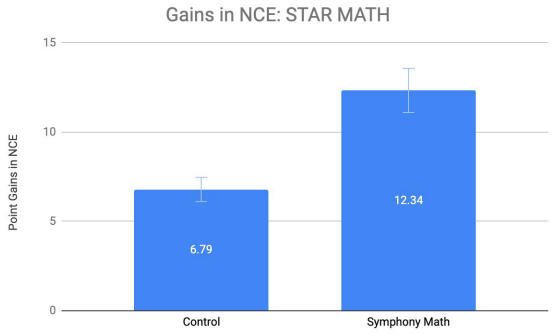
Based on this information, an independent samples t-test was used to compare the groups on their pre-NCE scores. The groups were not significantly different on their pre-NCE scores, p = .574. Based on this finding, difference scores (post-test minus pre-test) were calculated for NCE. The NCE difference scores were then tested for outliers, violations of normality, and violations of variance. Potential outliers were present in both groups; however, the researcher wished to keep this data. For the control group, the Kolmogorov-Smirnov test was passed, p =.200, but the Shapiro-Wilk test was violated, p = .001. For the treatment group, both Kolmogorov-Smirnov (p = .004) and Shapiro-Wilk tests of normality were violated, p < .001. However, the NCE difference scores passed Levene's test for equality of variance, p =.430.

Based on this information, an independent samples t-test was used to compare the groups on their NCE difference scores. This test was significant, $t(1201) = -7.23$, p < .001, 95% CI [-7.05, -4.04], with the treatment group having higher NCE difference scores (M = 12.34, SD = 13.61) than the control group (M = 6.79, SD = 12.99).

Results

Comparison of results from the STAR growth report showed a significant difference in gains in student NCE using 579 students from the Symphony Math (treatment) group and 624 students from the control group.

Students who used Symphony Math were seen to gain an average of 12.34 NCE points during the course of the school year. Their peers who did not use Symphony Math gained an average of 6.79 NCE points.



	Pre NCE	Post NCE	Difference
Control	60.1771	66.9675	6.79
Symphony Math	60.7779	73.1138	12.34

Conclusion

Graves County identified foundational number sense as a critical need of all students. During the 2018-19 school year, a study was undertaken to research the results of adding Symphony Math to support students in the goal of mastering key components of numeracy that enable math success. The district implemented the program as a regular part of students' week, and also supported teachers by including data review and focused Math Specialist interventions for struggling students.

When observing growth as measured by an independent assessment instrument, and comparing students to their peers in the district, students who used Symphony Math made significant growth during the course of the school year, and also outperformed their peers.

Appendix A: Student Analysis

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Case Processing Summary

	Cases					
	Valid	Missing	Total			
	N	Percent	N	Percent	N	Percent
0 = control, 1 = treatment * School	1203	97.6%	30	2.4%	1233	100.0%
0 = control, 1 = treatment * Grade	1203	97.6%	30	2.4%	1233	100.0%
0 = control, 1 = treatment * Class	1203	97.6%	30	2.4%	1233	100.0%

0 = control, 1 = treatment * School Crosstabulation

Count

	School	Total							
	A	B	C	D	E	F	G		
0 = control, 1 = treatment	0	228	126	54	106	67	43	0	624
	1	0	0	48	107	70	188	166	579
Total	228	126	102	213	137	231	166	1203	

0 = control, 1 = treatment * Grade Crosstabulation

Count

	Grade	Total				
	1	2	3	4		
0 = control, 1 = treatment	0	75	78	220	251	624
	1	213	202	90	74	579
Total	288	280	310	325	1203	

0 = control, 1 = treatment * Class Crosstabulation

Count

	Class	Total											
	1	2	3	4	5	6	7	8	9	10	11		
0 = control, 1 = treatment	0	41	43	39	62	77	54	92	51	98	47	20	624
	1	89	107	74	72	55	56	78	48	0	0	0	579
Total	130	150	113	134	132	110	170	99	98	47	20	1203	

Explore

Notes

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0 = control, 1 = treatment

	0 = control, 1 = treatment	Cases					
		Valid	Missing	Total			
		N	Percent	N	Percent	N	Percent
Pre_SS	0	624	100.0%	0	0.0%	624	100.0%
	1	579	100.0%	0	0.0%	579	100.0%
Pre_PR	0	624	100.0%	0	0.0%	624	100.0%
	1	579	100.0%	0	0.0%	579	100.0%
Pre_NCE	0	624	100.0%	0	0.0%	624	100.0%
	1	579	100.0%	0	0.0%	579	100.0%

Descriptives

	0 = control, 1 = treatment		Statistic	Std. Error
Pre_SS	0	Mean	538.8125	5.37147
		95% Confidence Interval for Mean	Lower Bound	528.2641
			Upper Bound	549.3609
		5% Trimmed Mean	544.8262	
		Median	566.0000	
		Variance	18004.108	
		Std. Deviation	134.17939	
		Minimum	127.00	
		Maximum	809.00	
		Range	682.00	
		Interquartile Range	187.75	
		Skewness	-0.706	0.098
		Kurtosis	-0.109	0.195
	1	Mean	440.7893	5.50926
		95% Confidence Interval for Mean	Lower Bound	429.9687
			Upper Bound	451.6099
		5% Trimmed Mean	441.1976	
		Median	433.0000	
		Variance	17573.748	

		Std. Deviation	132.56601		
		Minimum	57.00		
		Maximum	811.00		
		Range	754.00		
		Interquartile Range	199.00		
		Skewness	0.034	0.102	
		Kurtosis	-0.453	0.203	
Pre_PR	0	Mean	64.8141	1.05521	
		95% Confidence Interval for Mean	Lower Bound	62.7419	
			Upper Bound	66.8863	
		5% Trimmed Mean	66.1873		
		Median	73.0000		
		Variance	694.800		
		Std. Deviation	26.35906		
		Minimum	1.00		
		Maximum	99.00		
		Range	98.00		
		Interquartile Range	41.00		
		Skewness	-0.688	0.098	
		Kurtosis	-0.625	0.195	
	1	Mean	65.8480	1.03696	
		95% Confidence Interval for Mean	Lower Bound	63.8113	
			Upper Bound	67.8847	
		5% Trimmed Mean	67.2800		
		Median	71.0000		
		Variance	622.589		
		Std. Deviation	24.95174		
		Minimum	1.00		
		Maximum	99.00		
		Range	98.00		
		Interquartile Range	37.00		
		Skewness	-0.721	0.102	
		Kurtosis	-0.329	0.203	
Pre_NCE	0	Mean	60.1771	0.75493	

		95% Confidence Interval for Mean	Lower Bound	58.6946	
			Upper Bound	61.6596	
		5% Trimmed Mean	60.7196		
		Median	62.9000		
		Variance	355.630		
		Std. Deviation	18.85815		
		Minimum	1.00		
		Maximum	99.00		
		Range	98.00		
		Interquartile Range	25.40		
		Skewness	-0.431	0.098	
		Kurtosis	0.009	0.195	
	1	Mean	60.7779	0.75273	
		95% Confidence Interval for Mean	Lower Bound	59.2995	
			Upper Bound	62.2563	
		5% Trimmed Mean	61.3475		
		Median	61.7000		
		Variance	328.059		
		Std. Deviation	18.11240		
		Minimum	1.00		
		Maximum	99.00		
		Range	98.00		
		Interquartile Range	23.70		
		Skewness	-0.462	0.102	
		Kurtosis	0.380	0.203	

Extreme Values

	0 = control, 1 = treatment			Case Number	Student	Value
Pre_SS	0	Highest	1	508	14	809.00
			2	595	2	802.00
			3	554	15	790.00
			4	562	3	776.00
			5	579	3	776.00
		Lowest	1	44	11	127.00
			2	50	17	141.00
			3	75	24	151.00

			4	68	17	169.00
			5	28	11	172.00
	1	Highest	1	1155	5	811.00
			2	1192	16	766.00
			3	1183	7	756.00
			4	1203	27	733.00
			5	1153	3	721.00
		Lowest	1	760	1	57.00
			2	640	16	117.00
			3	716	14	121.00
			4	744	4	127.00
			5	867	12	128.00
Pre_PR	0	Highest	1	76	1	99.00
			2	160	7	99.00
			3	162	9	99.00
			4	170	1	99.00
			5	176	7	99.00
		Lowest	1	551	12	1.00
			2	227	7	1.00
			3	225	5	1.00
			4	434	40	2.00
			5	250	15	2.00
	1	Highest	1	777	18	99.00
			2	790	13	99.00
			3	908	14	99.00
			4	927	3	99.00
			5	1031	14	99.00
		Lowest	1	1147	18	1.00
			2	1143	14	1.00
			3	1136	7	1.00
			4	760	1	1.00
			5	1150	21	2.00
Pre_NCE	0	Highest	1	76	1	99.00
			2	160	7	99.00
			3	162	9	99.00
			4	170	1	99.00
			5	176	7	99.00
		Lowest	1	551	12	1.00
			2	227	7	1.00
			3	225	5	1.00
			4	434	40	6.70

			5	250	15	6.70
	1	Highest	1	777	18	99.00
			2	790	13	99.00
			3	908	14	99.00
			4	927	3	99.00
			5	1031	14	99.00
		Lowest	1	1147	18	1.00
			2	1143	14	1.00
			3	1136	7	1.00
			4	760	1	1.00
			5	1150	21	6.70

Tests of Normality

	0 = control, 1 = treatment	Kolmogorov-Smirnov		Shapiro-Wilk			
		Statistic	df	Sig.	Statistic	df	Sig.
Pre_SS	0	0.097	624	0.000	0.954	624	0.000
	1	0.041	579	0.023	0.993	579	0.013
Pre_PR	0	0.128	624	0.000	0.919	624	0.000
	1	0.104	579	0.000	0.932	579	0.000
Pre_NCE	0	0.069	624	0.000	0.985	624	0.000
	1	0.036	579	0.077	0.984	579	0.000

Oneway

Notes

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Descriptives

						95% Confidence Interval for Mean		Minimum	
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Maximum	
Pre_SS	0	624	538.8125	134.17939	5.37147	528.2641	549.3609	127.00	809.00
	1	579	440.7893	132.56601	5.50926	429.9687	451.6099	57.00	811.00
	Total	1203	491.6342	142.06673	4.09600	483.5982	499.6703	57.00	811.00
Pre_PR	0	624	64.8141	26.35906	1.05521	62.7419	66.8863	1.00	99.00
	1	579	65.8480	24.95174	1.03696	63.8113	67.8847	1.00	99.00
	Total	1203	65.3117	25.68590	0.74056	63.8588	66.7647	1.00	99.00
Pre_NCE	0	624	60.1771	18.85815	0.75493	58.6946	61.6596	1.00	99.00
	1	579	60.7779	18.11240	0.75273	59.2995	62.2563	1.00	99.00
	Total	1203	60.4663	18.49774	0.53332	59.4199	61.5126	1.00	99.00
Post_SS	0	624	635.3494	114.55951	4.58605	626.3434	644.3553	302.00	924.00
	1	579	573.0484	116.56075	4.84410	563.5342	582.5625	139.00	865.00
	Total	1203	605.3641	119.60426	3.44837	598.5986	612.1296	139.00	924.00
Post_PR	0	624	73.7051	24.69862	0.98874	71.7635	75.6468	1.00	99.00
	1	579	80.6114	20.44427	0.84963	78.9427	82.2801	1.00	99.00
	Total	1203	77.0291	23.00174	0.66317	75.7280	78.3302	1.00	99.00
Post_NCE	0	624	66.9675	18.70588	0.74883	65.4969	68.4380	1.00	99.00
	1	579	73.1138	17.46719	0.72591	71.6881	74.5396	1.00	99.00
	Total	1203	69.9257	18.37149	0.52968	68.8865	70.9649	1.00	99.00

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Pre_SS	0.009	1	1201	0.924
Pre_PR	3.926	1	1201	0.048
Pre_NCE	1.536	1	1201	0.215
Post_SS	0.160	1	1201	0.689
Post_PR	25.181	1	1201	0.000
Post_NCE	2.240	1	1201	0.135

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pre_SS	Between Groups	2885727.713	1	2885727.713	162.147	0.000
	Within Groups	21374185.356	1201	17796.990		
	Total	24259913.069	1202			
Pre_PR	Between Groups	321.044	1	321.044	0.486	0.486
	Within Groups	792717.061	1201	660.048		
	Total	793038.105	1202			
Pre_NCE	Between Groups	108.410	1	108.410	0.317	0.574
	Within Groups	411175.619	1201	342.361		
	Total	411284.030	1202			
Post_SS	Between Groups	1165702.043	1	1165702.043	87.342	0.000
	Within Groups	16029122.486	1201	13346.480		
	Total	17194824.529	1202			
Post_PR	Between Groups	14324.673	1	14324.673	27.676	0.000
	Within Groups	621629.308	1201	517.593		
	Total	635953.982	1202			
Post_NCE	Between Groups	11345.717	1	11345.717	34.554	0.000
	Within Groups	394343.419	1201	328.346		
	Total	405689.136	1202			

Robust Tests of Equality of Means

		Statistic	df1	df2	Sig.
Pre_SS	Welch	162.294	1	1196.277	0.000
Pre_PR	Welch	0.488	1	1200.518	0.485
Pre_NCE	Welch	0.318	1	1199.567	0.573
Post_SS	Welch	87.228	1	1190.872	0.000
Post_PR	Welch	28.065	1	1185.836	0.000
Post_NCE	Welch	34.732	1	1200.951	0.000

T-Test

Notes

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Group Statistics

	0 = control, 1 = treatment	N	Mean	Std. Deviation	Std. Error Mean
Pre_SS	0	624	538.8125	134.17939	5.37147
	1	579	440.7893	132.56601	5.50926
Pre_NCE	0	624	60.1771	18.85815	0.75493
	1	579	60.7779	18.11240	0.75273

Independent Samples Test

		Levene's Test for Equality of Variances	t-test for Equality of Means							
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre_SS	Equal variances assumed	0.009	0.924	12.734	1201	0.000	98.02321	7.69794	82.92030	113.12611
	Equal variances not assumed			12.739	1196.277	0.000	98.02321	7.69445	82.92708	113.11934
Pre_NCE	Equal variances assumed	1.536	0.215	-0.563	1201	0.574	-0.60081	1.06769	-2.69555	1.49393
	Equal variances not assumed			-0.564	1199.567	0.573	-0.60081	1.06607	-2.69239	1.49077

Explore

Notes

Output Created	23-FEB-2020 17:20:30	
Comments		
Input	Data	C:\Users\sqwig\OneDrive\Desktop\Current Clients\Paul\Graves Detailed Data.sav
	Filter	<none>
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	N of Rows in Working Data File	1233
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.
Syntax	EXAMINE VARIABLES=NCE_Difference_Score BY Group /ID= Student /PLOT BOXPLOT HISTOGRAM NPPLOT /COMPARE GROUP /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.	
Resources	Elapsed Time	0:00:01.66

0 = control, 1 = treatment

Case Processing Summary

		Cases					
		Valid	Missing	Total			
	0 = control, 1 = treatment	N	Percent	N	Percent	N	Percent
NCE_Difference_Score	0	624	100.0%	0	0.0%	624	100.0%
	1	579	100.0%	0	0.0%	579	100.0%

Descriptives

	0 = control, 1 = treatment		Statistic	Std. Error	
NCE_Difference_Score	0	Mean	6.7904	0.51997	
		95% Confidence Interval for Mean	Lower Bound	5.7693	

			Upper Bound	7.8115	
		5% Trimmed Mean	6.6751		
		Median	7.2000		
		Variance	168.713		
		Std. Deviation	12.98896		
		Minimum	-41.40		
		Maximum	66.50		
		Range	107.90		
		Interquartile Range	16.95		
		Skewness	0.190	0.098	
		Kurtosis	1.134	0.195	
	1	Mean	12.3359	0.56578	
		95% Confidence Interval for Mean	Lower Bound	11.2247	
			Upper Bound	13.4472	
		5% Trimmed Mean	12.0156		
		Median	11.3000		
		Variance	185.341		
		Std. Deviation	13.61400		
		Minimum	-29.50		
		Maximum	59.70		
		Range	89.20		
		Interquartile Range	16.50		
		Skewness	0.416	0.102	
		Kurtosis	0.815	0.203	

Tests of Normality

	0 = control, 1 = treatment	Kolmogorov-Smirnov	Shapiro-Wilk				
		Statistic	df	Sig.	Statistic	df	Sig.
NCE_Difference_Score	0	0.028	624	0.200	0.991	624	0.001
	1	0.047	579	0.004	0.986	579	0.000

NCE_Difference_Score

Oneway

Notes

Output Created	23-FEB-2020 17:21:32	
Comments		
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	N of Rows in Working Data File	1233
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on cases with no missing data for any variable in the analysis.
Syntax	ONEWAY NCE_Difference_Score BY Group /STATISTICS HOMOGENEITY /MISSING ANALYSIS .	
Resources	Elapsed Time	0:00:00.03

Test of Homogeneity of Variances

NCE_Difference_Score

Levene Statistic	df1	df2	Sig.
0.623	1	1201	0.430

ANOVA

NCE_Difference_Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9236.025	1	9236.025	52.265	0.000
Within Groups	212235.375	1201	176.716		
Total	221471.400	1202			

T-Test

Notes

Output Created	23-FEB-2020 17:22:04	

Comments		
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	N of Rows in Working Data File	1233
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax	T-TEST GROUPS = Group(0 1) /MISSING = ANALYSIS /VARIABLES = NCE_Difference_Score /CRITERIA = CI(.95) .	
Resources	Elapsed Time	0:00:00.06

Group Statistics

	0 = control, 1 = treatment	N	Mean	Std. Deviation	Std. Error Mean
NCE_Difference_Score	0	624	6.7904	12.98896	0.51997
	1	579	12.3359	13.61400	0.56578

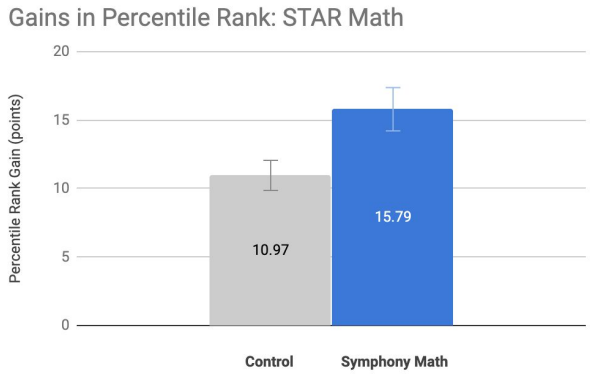
Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
NCE_Difference_Score	Equal variances assumed	0.623	0.430	-7.229	1201	0.000	-5.54554	0.76708	-7.05050	-4.04058
	Equal variances not assumed			-7.217	1183.450	0.000	-5.54554	0.76843	-7.05317	-4.03791

Appendix B: Preliminary Group Analysis

NOTE: This data was not used in the formal conclusions, but is included for transparency. It was determined after preliminary analysis that National Curve Equivalent (NCE) was a better statistic to use with group averaging. https://stats.idre.ucla.edu/stata/faq/how-should-i-analyze-percentile-rank-data/

STAR Math Assessment Data per grouping (and Symphony Math Use)



		Fall 2018		Spring 2019		Gain
Group	n	Mean	SD	Mean	SD	
Symphony	29	69.28	7.78	85.07	6.96	15.79**
Control	29	66.17	14.42	77.14	10.56	10.97

** Statistically significant at the p<0.01 level

Methodology: A Mann-Whitney U test revealed that the treatment (n = 29) and control (n = 29) groups were significantly different on their post-PR gain scores, (U = 203.50, Z = -3.38, p < .001). The median for the control group for post-PR gain score was 79 (quartile range: 71.50 to 84.50), the treatment group's median was 85 (quartile range: 82.50 to 89.50).

Control						
School	**Grade**	**Class Grouping**	**Pre Percentile Rank**	**Post Percentile Rank**	***n***	***(No Symphony Math Use)***
School A	1	A	70	89	17	
School A	1	B	38	64	16	

School B	1	A	62	81	24	
School A	2	C	47	68	18	
School A	2	D	62	82	26	
School A	2	E	76	86	25	
School B	2	B	60	76	27	
School C	3	A	82	79	16	
School C	3	B	93	93	17	
School D	3	A	59	75	25	
School D	3	B	82	87	34	
School A	3	F	64	78	19	
School A	3	G	78	84	23	
School A	3	H	64	78	19	
School B	3	C	52	67	21	
School B	3	D	63	76	20	
School E	3	A	36	59	18	
School E	3	B	74	75	18	
School C	4	C	71	80	21	
School F	4	A	75	85	43	
School D	4	C	36	44	25	
School D	4	D	88	93	32	
School A	4	I	75	74	23	
School A	4	J	64	67	22	
School A	4	K	74	69	20	
School B	4	E	66	79	17	
School B	4	F	72	81	17	
School E	4	C	78	89	14	
School E	4	D	58	79	17	
Treatment (Symphony)						
School	**Grade**	**Class Grouping**	**Pre Percentile Rank**	**Post Percentile Rank**	***n***	***Avg. Use Symphony Math (hours)***
School F	1	B	64	83	20	28
School F	1	C	68	75	19	22
School F	1	D	78	93	19	31.5
School E	1	E	62	89	20	31

School E	1	F	56	83	20	22.5
School D	1	E	70	89	18	14.5
School D	1	F	71	88	19	6
School D	1	G	67	84	18	17
School C	1	D	85	94	14	24.5
School C	1	E	81	95	15	24.5
School G	1	A	66	85	17	24
School G	1	B	62	79	15	24
School F	2	E	71	82	18	23
School F	2	F	62	71	19	23
School F	2	G	63	80	20	23
School E	2	G	67	84	16	38
School E	2	H	76	87	14	38
School D	2	H	69	85	18	19
School D	2	I	73	85	17	16
School D	2	J	76	90	17	17.5
School C	2	F	58	90	20	19
School G	2	C	76	94	21	24
School G	2	D	71	91	22	24
School F	3	H	70	83	52	24
School G	3	E	75	86	19	20
School G	3	F	81	88	19	20
School F	4	I	51	63	21	26
School G	4	G	67	82	26	19.5
School G	4	H	73	89	27	19.5

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This study included many people in the planning, participation, and post-study analysis. The talented and dedicated educators in Graves County were very thorough in the identification of control and treatment groups, and followed through with a very consistent and uniform implementation. Their energy helped the students in Graves County use Symphony Math following the best practices. Academic Edge helped to train and support educators as they used the data dashboards and offline materials during the year.. Toby Caplin helped enormously in the draft and editing of this document. Kelsey Carlson, PhD, provided a much-needed critique of the original statistics used in the original findings of the study. Her work in providing a proper and thorough analysis validated the original findings and is greatly appreciated.

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