The Effects of Thinking Maps in Raising Student Achievement: A Retrospective Study of Outcomes from Implementing Schools

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EXECUTIVE SUMMARY

This study retroactively examined the impact of the Thinking Maps program on school-level achievement outcomes in reading and math. Thinking Maps is a school-wide instructional program that involves the use of tailored graphic organizers representing consistent visual patterns that are aligned to the core cognitive processes of the brain. Students use Thinking Maps to create visual patterns for problems they are solving and to help them reach higher levels of critical and creative thinking.

Using school-level achievement data gathered from state department of education data warehouses, logistic regression analyses were used to examine whether or not schools using the Thinking Maps program are significantly more or less likely to surpass the reading and math achievement growth exhibited in their respective school districts. These analyses examined the achievement outcomes of roughly 70 elementary and middle schools while controlling for school and district demographic characteristics and prior achievement.

Analyses indicated that across grades 2 to 8, schools that used Thinking Maps outpaced the achievement growth exhibited in their districts at a statistically significant level. These results appeared after the first and second year of program use in reading and after the second year of use in math. After controlling for demographic characteristics and prior achievement, schools using Thinking Maps were 1.98 (Year One reading; $p < .01$), 1.77 (Year Two reading; $p < .05$), and 2.72 (Year Two math; $p < .001$) times more likely to surpass, rather than be surpassed by, the growth achieved in their respective school districts during this same time. Sub-analyses that examined the impact of Thinking Maps on individual grade levels also indicated significant results favoring program schools for grades 3 to 5. Given the limitations of the study's school-level analyses, additional research is recommended to buttress these promising initial findings. Findings from this and future research can serve a valuable role in informing the adoption and future implementation of this innovative program.

The Effects of Thinking Maps in Raising Student Achievement: A Retrospective Study of Outcomes from Implementing Schools

The present report summarizes the results of a retrospective quasi-experimental study of Thinking Maps. The study was designed to compare pre- to post-program student achievement scores in schools that implemented Thinking Maps in different states relative to the average performance of schools in the same districts. Thinking Maps, Inc. is a North Carolina based company that has been training teachers for over 28 years on how to successfully implement Thinking Maps as a school-wide program. As described by the company's leadership, Thinking Maps are consistent visual patterns that are aligned to the core cognitive processes of the brain. Students use Thinking Maps to create visual patterns for problems they are solving and to help them reach higher levels of critical and creative thinking[1]. Thinking Maps is implemented in school-wide settings such that every teacher participates in the in-depth training on how to use the maps in the classroom. The goal of this approach is to create a consistent language for learning that becomes part of the common language and set of common practices within the school. The simplicity of the maps is considered one of their greatest strengths.

For purposes of the present study, Thinking Maps, Inc. identified 73 schools that have implemented the Thinking Maps program since 2010. The sample included elementary and middle schools that contain state-assessed grades (i.e., 3rd-8th). As the evaluators, Johns Hopkins University's Center for Research and Reform in Education (JHU CRRE) conducted analyses that examined if those schools achieved higher levels of student achievement as compared to what is typical in their districts. To be eligible for the sample, each school minimally must have had one year of pre-program and two years of post-program student achievement data on their respective state's lead standardized assessment. The primary research questions were:

1. How do schools that implemented Thinking Maps compare with district averages in mathematics and reading achievement?

2. Do the impacts of Thinking Maps on student achievement in mathematics and reading vary across different contexts (e.g., grade-levels)?

[1] see https://www.thinkingmaps.com/why-thinking-maps-2/

Method

Research Design

This study involved conducting post-hoc analyses of school-level student reading and mathematics achievement of schools that have used the Thinking Maps program for a minimum of two years. Achievement data were gathered from state department of education public data warehouses by Thinking Maps Inc. The data collected included the percentage of students achieving proficient and advanced levels on state achievement assessments in Thinking Maps schools and the percentage of students achieving these levels in each school's respective district. To complement these data, Thinking Maps Inc. provided demographic data for each participating school and school district. Demographic data for each school were gathered from the National Center for Education Statistics (NCES) database.

Participants

The initial participant group for this study consisted of 73 schools spanning eight states[2]. All participants were public schools that served some combination of grades 2 to 8. The participant group was identified by Thinking Maps Inc. and consisted of U.S. public schools that had implemented the program for a minimum of two years and had publically available achievement data that spanned at least three years (i.e., one year prior to program implementation and two years after initial implementation). In order to generate the necessary statistical power for inferential analyses to detect effects, schools that met these criteria were included in the treatment group regardless of the specific years they used the Thinking Maps program.

Within the treatment group, the initial year of program implementation ranged from 2009 through 2017, and included states ranging from the Northeast (e.g., New York) to the West Coast of the United States (e.g., California). Despite these ranges in geography and timing of implementation, the majority of schools were clustered in a relatively small number of states and began implementation in a similar timeframe. Over half of the treatment group began Thinking Maps implementation in either the 2014-15 or 2015-16 school years. The majority of schools were from California and Florida, though a substantive number were located in Georgia, North Carolina, and Arizona as well. Table 1 below provides a matrix breakdown of the states and initial years of implementation for the schools included in the study.

Table 1
Treatment Group: School Locations and Initial Year of Implementation

	AZ	CA	CO	FL	GA	NC	NY	TX	*Total*
2009	-	-	1	-	-	-	-	-	*1*
2010	-	-	-	1	-	1	-	-	*3*
2011	1	1	-	1	2	-	-	2	*7*
2012	-	1	-	3	2	-	-	1	*7*

[2] Due to differences in the available data among participant schools, the treatment sample varied slightly between the various analyses conducted. Sample size statistics for each of the analyses are provided in the Appendix.

2013	2	5	-	-	-	-	-	-	*7*
2014	1	4	-	7	3	1	-	-	*16*
2015	3	4	-	4	2	5	-	-	*18*
2016	-	3	-	-	2	3	1	-	*9*
2017[3]	2	-	-	-	-	-	3	-	*5*
Total	*9*	*19*	*1*	*16*	*11*	*10*	*4*	*3*	*73*

As summarized in Table 2, overall, the demographic composition of the schools in the treatment group was similar to that of the districts in which they were housed. On average, the majority of students in the treatment schools qualified for free or reduced price meals. The schools served ethnically diverse student populations, as no individual ethnic group totaled more than half of the group's enrollment. Latino/Hispanic students were the largest demographic in the schools and their corresponding districts. In the school year prior to beginning Thinking Maps implementation, on average, the treatment schools had nearly identical achievement to that of their respective districts at the time.

Table 2
Treatment Schools and Comparison Districts: Demographic Characteristics[4]

	Treatment Schools	Comparison Districts
Demographic Characteristics		
African American %	10.01%	13.70%
Asian %	3.22%	3.30%
Hispanic %	43.59%	40.98%
White %	39.17%	38.24%
Free/Reduced Lunch %	63.77%	60.31%
Baseline Achievement		
Reading: Proficient or Advanced %	56.05%	56.82%
Reading: Advanced %	25.68%	24.10%
Math: Proficient or Advanced %	56.87%	56.72%
Math: Advanced %	28.50%	27.19%

Measures

Student achievement was measured using school-level pass rates on the lead state accountability measures given in each of the eight states during the study window. Because this study encompassed the years 2009 through 2018, these exams included the Common Core aligned Partnership for Assessment of Readiness for College and Careers (PARCC) and Smarter Balanced Assessment Consortium (SBAC) assessments along with other summative assessments utilized in

[3] Due to the availability of data, schools beginning implementation in 2017 were included in the Year One analyses only.
[4] Demographic statistics are aggregated across grade level cohorts based on the available data. Calculations do not account for differences in total student enrollment between grade level cohorts.

the participating states to measure student mastery of state curriculum standards. The percentage of students who passed these exams (i.e., scored at the "proficient" or "advanced" level) and the percentage of students who scored in the "advanced" category were collected for each participating school and each school district.

School-level achievement data for these assessments were compiled from state department of education data warehouses by Thinking Maps Inc. This process involved the Thinking Maps project team pooling necessary data from online public data repositories for each school. All data were double entered and checked by separate Thinking Maps team members to ensure completeness and correctness. To compliment these data, demographic data were gathered for each school, and each school's respective district from the National Center for Education Statistics (NCES) online database. These data were gathered by both Thinking Maps Inc., and the CRRE research team and included data reflecting the socio-economic and racial/ethnic composition of each school/district's student body[5].

Analytic Approach

Logistic regression analyses were conducted to determine if there was a significant difference in the performance of treatment schools utilizing the Thinking Maps program and other schools within these schools' respective districts. These analyses compared the growth rates, in terms of the percentage of students achieving "proficient" or "advanced" status on state achievement tests, between each Thinking Maps school and their respective school district while controlling for several covariates. These covariates included: Each school/district's baseline proficiency rates on the state exam in reading and math, the percentage of students in each school/district who were Asian, African-American, Hispanic, or White, the percentage of students in each school/district who qualified for free or reduced priced meals, and a vector of dummy variables identifying the state the school/district was located in, the grade level participating[6], and the baseline year that each school began using Thinking Maps[7].

While statistically controlling for these variables, the analyses examined the likelihood of Thinking Maps schools exceeding the achievement growth of that exhibited in their respective districts during this same time. This analytic approach (logistic regression) was selected to more equitably compare the treatment schools against the performance of their school districts. In specific, because the performance of each Thinking Maps school contributed to the average

[5] Given possible differences in reporting between state data warehouses and NCES, all data gathered from NCES were pulled for the 2016-17 school year (at the time of this study, the most recent available from NCES). Due to the limited sample size of this study, to facilitate a more parsimonious analysis, using a single year for demographic data was viewed as preferable given the limited number of covariates available to incorporate in the analysis.

[6] Grade levels within schools were treated separately in the analysis rather than aggregated together. In other words, each grade level in each school was compared against the achievement of that specific grade level in the school's district. This was necessary given the lack of available school enrollment data and to account for differences in the specific grade levels in which schools implemented the program. For purposes of enhancing clarity of this report, schools, rather than classes, are referred to as the treatment unit for the main analyses.

[7] In an effort to control for differences in state exams between treatment schools, a vector of dummy variables was incorporated that included the eight states (Arizona, California, Colorado, Florida, Georgia, North Carolina, New York, and Texas). Given potential changes that happened within states during the study window with regard to the assessments provided, a vector of dummy variables was also included that identified the baseline year in which each school began using Thinking Maps (2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017).

performance calculated across each school district (i.e., district averages encompass all the schools in the district, including the Thinking Maps schools), the assumption of independent errors, a key prerequisite for linear regression, was violated. To help address this issue and to control for the interrelationship between district and school achievement calculations, student achievement growth was simplified from a continuous to a dichotomous variable: Whether or not each school or each school's district achieved greater achievement growth[8]. For these analyses, schools were used as the main level of analysis. Given the small number of districts/states and limited statistical power however, hierarchical analyses with schools nested within states was not possible.

For grade levels with the greatest concentration of Thinking Maps participation (3^{rd}-5^{th}), analyses were also conducted that examined the specific impact of the program in each of these grades individually. Due to limited sample size, these sub-analyses were not possible for grades 2^{nd} or 6^{th}-8^{th}, however. Sample size statistics for each of the analyses are provided in the Appendix.

[8] Grade levels within schools were treated separately in the analysis rather than aggregated together. Each grade level in each school was compared against the achievement of that specific grade level in the school's district. This was necessary given the lack of available school enrollment data and to account for differences in the specific grade levels that schools implemented the program. For purposes of narrative clarity, for the combined analyses, treatment units are referred to as schools or sites throughout this report.

Results

School Reading Achievement

The following section discusses the results of analyses which examined the relationship between Thinking Maps implementation and school reading achievement. Results are summarized for all grade levels combined (second through eighth) as well as for select grade levels individually. Year One analyses compared the achievement growth of Thinking Maps sites with that of their respective school districts at the conclusion of the first year the program was implemented. Year Two analyses compared the achievement growth (as measured over two years) at the conclusion of the second year that sites implemented the program.

Year One. After implementing the Thinking Maps program for one year, school achievement on state reading tests was analyzed in relation to district averages. Here, school percent proficient and percent advanced rates were compared between each Thinking Maps school and the same rates for their respective school districts. After controlling for the covariates, on average, Thinking Maps schools had more students achieve proficient or advanced status on the state exam than the other schools in their respective districts (56.49% vs. 52.79%). Thinking Maps sites were 1.98 times more likely to surpass, rather than be surpassed by, the growth achieved in their district during this time ($p < .01$). Put differently, after accounting for the covariates, after one year of program implementation Thinking Maps sites surpassed the reading achievement growth of their respective districts 66.44% of the time, while 33.56% of the time, the districts achieved greater growth.

For grade levels with the greatest concentration of Thinking Maps participation, analyses were also conducted that examined the specific impact of the program in each of these grades individually. Due to limited sample size and the data available, these sub-analyses were limited to grades third, fourth, and fifth. After controlling for the covariates, analyses indicated that after one year, Thinking Maps fifth graders were significantly more likely to exceed, rather than be exceeded by, the proficient/advanced rates exhibited by the other fifth graders in their respective district. The analyses did not yield statistically significant differences for third or fourth grade. Full results of the analyses for Year One are presented in Tables 3-4. Results for each grade level are summarized below.

- ***Third Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved proficient or advanced status than the third graders attending other schools in their respective districts (56.31% vs. 52.18%). Moreover, Thinking Maps third grades were 2.59 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time. This result, however, was not statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved advanced status than those attending the other schools

in their respective districts (25.39% vs. 23.26%). Thinking Maps third grades were 1.77 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time. This result was not statistically significant.

- ***Fourth Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fourth graders achieved proficient or advanced status than the fourth graders attending other schools in their respective districts (55.95% vs. 53.56%). However, Thinking Maps fourth grades, by a slight margin, were more likely to be surpassed by, rather than surpass (0.76), the growth of their respective districts during this time. This result was not statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fourth graders achieved advanced status than the fourth graders attending other schools in their respective districts (26.18% vs. 23.21%). However, Thinking Maps fourth grades, by a slight margin, were more likely to be surpassed by, rather than surpass (0.66), the growth of their respective districts during this time. This result was not statistically significant.

- ***Fifth Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fifth graders achieved proficient or advanced status than the fifth graders attending other schools in their respective districts (57.69% vs. 53.27%). Additionally, Thinking Maps fifth grades were 2.80 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fifth grade classes in their district during this time. This result was statistically significant ($p < .05$).

    - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fifth graders achieved advanced status than the fifth graders attending other schools in their respective districts (25.39% vs. 23.10%). However, Thinking Maps fifth grades, by a very slight margin, were more likely to be surpassed by, rather than surpass (0.91), the growth of their respective districts during this time. This result was not statistically significant.

Table 3
Treatment Schools and Comparison Districts: Year One Reading

		Treatment Schools M (SE)	Comparison Districts M (SE)
3rd Grade	% Proficient	56.309 (1.581)	52.178 (1.774)
	% Advanced	25.389 (0.985)	23.255 (1.096)

4th Grade	% Proficient	55.951 (1.207)	53.560 (1.371)
	% Advanced	26.183 (1.089)	23.208 (1.241)
5th Grade	% Proficient	57.685 (1.308)	53.267 (1.487)
	% Advanced	25.386 (0.839)	23.097 (0.957)
Overall	% Proficient	56.468 (0.710)	52.787 (0.813)
	% Advanced	24.699 (0.543)	22.455 (0.620)

Note. All percentages are adjusted to account for the covariates included in the analysis (see Analytic Approach section). Standard errors are presented alongside the percentages displayed. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).

Table 4
Logistic Regression Results: Year One Reading

		β	SE	Wald's χ^2	*p*	Odds Ratio
3rd Grade	% Proficient	0.952	0.496	3.690	0.550	2.591
	% Advanced	0.569	0.496	1.318	0.251	1.767
4th Grade	% Proficient	-0.270	0.475	0.323	0.570	0.763
	% Advanced	-0.419	0.494	0.719	0.396	0.658
5th Grade	% Proficient	1.030	0.490	4.413	0.036	2.801
	% Advanced	-0.091	0.492	0.034	0.854	0.913
Overall	% Proficient	0.685	0.242	7.970	0.005	1.983
	% Advanced	0.051	0.246	0.043	0.837	1.052

Note 1. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).
Note 2. The sample sizes for the analyses were as follows: 3rd Grade: Treatment = 47 schools, Comparison = 38 districts; 4th Grade: Treatment = 48 schools, Comparison = 38 districts; 5th Grade: Treatment = 47 schools, Comparison = 37 districts; Overall: Treatment = 68 schools (178 grade level classes), Comparison = 48 districts (138 grade level comparisons)

Year Two. School-level achievement on state reading exams was also analyzed after schools had completed two years of Thinking Maps implementation. As with the Year One analyses, school percent proficient and percent advanced rates were compared between each Thinking Maps school and the same rates for their respective school districts. After controlling for the covariates, on average, Thinking Maps sites had more students achieve proficient or advanced status on the state exam than the other schools in their respective districts (54.01% vs. 50.46%). Thinking Maps sites were 1.77 times more likely to surpass, rather than be surpassed by, the growth achieved in their district during this time ($p < .05$). In other words, after accounting for the

covariates, after two years of program implementation Thinking Maps sites surpassed the reading achievement growth of their respective districts 63.90% of the time and were surpassed by their districts 36.10% of the time.

For grades third, fourth, and fifth (those with the greatest concentration of Thinking Maps participation), analyses were also conducted that examined the impact of the program in these grades individually. These analyses did not find statistically significant differences between the achievement growth of the Thinking Maps schools and what occurred across the other schools in the same school districts for these grade levels. Directional trends, however, generally favored the performance of the Thinking Maps schools by a slight margin in each of these grades. Results of the analyses for Year Two are presented in Tables 5-6 and results for each grade level are summarized below.

- ***Third Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps third graders achieved proficient or advanced status than the third graders attending other schools in their respective districts (52.78% vs. 50.91%). However, Thinking Maps third grades, by a slight margin, were more likely to be surpassed by, rather than surpass (0.61), the growth of their respective districts during this time. This result was not statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved advanced status than those attending the other schools in their respective districts (25.48% vs. 23.47%). Moreover, Thinking Maps third grades were 1.32 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time. This result was not statistically significant.

- ***Fourth Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fourth graders achieved proficient or advanced status than the fourth graders attending other schools in their respective districts (54.13% vs. 51.06%). Thinking Maps fourth grades were 1.76 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fourth grade classes in their district during this time. This result was not statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fourth graders achieved advanced status than the fourth graders attending other schools in their respective districts (26.36% vs. 23.46%). However, Thinking Maps fourth grades, by a slight margin, were more likely to be surpassed by, rather than surpass (0.39), the growth of their respective districts during this time. This result was not statistically significant.

- ***Fifth Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fifth graders achieved proficient or advanced status than the fifth graders attending other schools in their respective districts (54.06% vs. 50.79%). Moreover, Thinking Maps fifth grades were 1.60 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fifth grade classes in their district during this time. This result was not statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps fifth graders achieved advanced status than those attending the other schools in their respective districts (23.43% vs. 21.38%). Furthermore, Thinking Maps fifth grades were 1.55 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fifth grade classes in their district during this time. This result was not statistically significant.

Table 5
Treatment Schools and Comparison Districts: Year Two Reading

		Treatment Schools M (SE)	Comparison Districts M (SE)
3rd Grade	% Proficient	52.775 (1.527)	50.914 (1.714)
	% Advanced	25.484 (1.030)	23.473 (1.160)
4th Grade	% Proficient	54.126 (1.154)	51.057 (1.309)
	% Advanced	26.359 (0.940)	23.458 (1.071)
5th Grade	% Proficient	54.058 (1.231)	50.791 (1.386)
	% Advanced	23.427 (0.754)	21.379 (0.853)
Overall	% Proficient	54.011 (0.710)	50.458 (0.805)
	% Advanced	23.884 (0.511)	22.041 (0.582)

Note. All percentages are adjusted to account for the covariates included in the analysis (see Analytic Approach section). Standard errors are presented alongside the percentages displayed. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).

Table 6
Logistic Regression Results: Year Two Reading

		β	SE	Wald's χ^2	*p*	Odds Ratio
3rd Grade	% Proficient	-0.492	0.492	1.000	0.317	0.612
	% Advanced	0.280	0.499	0.314	0.575	1.323

4th Grade	% Proficient	0.568	0.478	1.407	0.235	1.764
	% Advanced	-0.943	0.504	3.503	0.061	0.390
5th Grade	% Proficient	0.470	0.478	0.967	0.325	1.600
	% Advanced	0.440	0.499	0.776	0.378	1.552
Overall	% Proficient	0.573	0.244	5.498	0.019	1.773
	% Advanced	-0.084	0.249	0.113	0.737	0.920

Note 1. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).
Note 2. The sample sizes for the analyses were as follows: 3rd Grade: Treatment = 47 schools, Comparison = 38 districts; 4th Grade: Treatment = 47 schools, Comparison = 37 districts; 5th Grade: Treatment = 45 schools, Comparison = 36 districts; Overall: Treatment = 68 schools (170 grade level classes), Comparison = 48 districts (134 grade level comparisons)

School Mathematics Achievement

Year One. After implementing Thinking Maps for one year, school achievement on state math tests was analyzed in relation to district averages. As with the analyses of school reading performance, school percent proficient and percent advanced rates were compared between each Thinking Maps school and the same rates for their respective districts. After controlling for the covariates, on average, Thinking Maps schools had more students achieve proficient or advanced status on the state exam in math than the other schools in their respective districts (55.72% vs. 52.91%). Thinking Maps schools were 1.52 times more likely to surpass, rather than be surpassed by, the growth achieved in their district during this time. This trend was not statistically significant, however.

For grade levels with the greatest concentration of Thinking Maps participation (third, fourth, and fifth), analyses were also conducted that examined the specific impact of the program in each of these grades individually. After controlling for the covariates, analyses did not find significant differences in the performance gains of the Thinking Maps schools in relation to that of their school districts for any of these grades individually. Directional trends, however, generally favored the performance of the Thinking Maps schools by a slight margin. Full results of the analyses for Year One are presented in Tables 7-8. Results for each grade level are summarized below.

- ***Third Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved proficient or advanced status than the third graders attending other schools in their respective districts (59.23% vs. 55.30%). Moreover, Thinking Maps third grades were 1.80 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time. This result was not statistically significant.

- *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved advanced status than those attending the other schools in their respective districts (28.72% vs. 27.67%). Thinking Maps third grades were 1.55 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time. This result was not statistically significant.

- ***Fourth Grade***

  - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fourth graders achieved proficient or advanced status than the fourth graders attending other schools in their respective districts (57.56% vs. 54.17%). Thinking Maps fourth grades were 1.25 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fourth grade classes in their district during this time. This result was not statistically significant.

  - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fourth graders achieved advanced status than the fourth graders attending other schools in their respective districts (28.69% vs. 26.76%). However, Thinking Maps fourth grades, by a very slight margin, were more likely to be surpassed by, rather than surpass (0.93), the growth of their respective districts during this time. This result was not statistically significant, however.

- ***Fifth Grade***

  - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fifth graders achieved proficient or advanced status than the fifth graders attending other schools in their respective districts (55.24% vs. 53.22%). Moreover, Thinking Maps fifth grades were 2.64 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fifth grade classes in their district during this time. This result was not statistically significant.

  - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fifth graders achieved advanced status than the fifth graders attending the other schools in their respective districts (27.76% vs. 27.32%). However, Thinking Maps fifth grades, by a very slight margin, were more likely to be surpassed by, rather than surpass (0.75), the growth of their respective districts during this time. This result was not calculated to be statistically significant.

Table 7
Treatment Schools and Comparison Districts: Year One Mathematics

		Treatment Schools M (SE)	Comparison Districts M (SE)
3rd Grade	% Proficient	59.227 (1.634)	55.303 (1.834)

	% Advanced	28.720 (1.517)	27.670 (1.709)
4th Grade	% Proficient	57.562 (1.410)	54.174 (1.600)
	% Advanced	28.688 (1.124)	26.755 (1.265)
5th Grade	% Proficient	55.235 (1.525)	53.221 (1.733)
	% Advanced	27.764 (0.996)	27.320 (1.137)
Overall	% Proficient	55.722 (0.774)	52.908 (0.886)
	% Advanced	27.234 (0.634)	26.595 (0.727)

Note. All percentages are adjusted to account for the covariates included in the analysis (see Analytic Approach section). Standard errors are presented alongside the percentages displayed. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).

Table 8
Logistic Regression Results: Year One Mathematics

		β	SE	Wald's χ^2	*p*	Odds Ratio
3rd Grade	% Proficient	0.586	0.481	1.484	0.223	1.797
	% Advanced	0.437	0.495	0.779	0.378	1.548
4th Grade	% Proficient	0.226	0.495	0.208	0.648	1.254
	% Advanced	-0.076	0.486	0.024	0.876	0.927
5th Grade	% Proficient	0.970	0.505	3.694	0.055	2.638
	% Advanced	-0.286	0.529	0.291	0.589	0.751
Overall	% Proficient	0.417	0.240	3.019	0.082	1.518
	% Advanced	-0.003	0.247	0.000	0.990	0.997

Note 1. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).
Note 2. The sample sizes for the analyses were as follows: 3rd Grade: Treatment = 47 schools, Comparison = 38 districts; 4th Grade: Treatment = 48 schools, Comparison = 38 districts; 5th Grade: Treatment = 47 schools, Comparison = 37 districts; Overall: Treatment = 68 schools (178 grade level classes), Comparison = 48 districts (138 grade level comparisons)

Year Two. School-level achievement on state mathematics exams was also analyzed after schools had completed two years of Thinking Maps implementation. As with the Year One analyses, school percent proficient and percent advanced rates were compared between each Thinking Maps school and the same rates for their respective school districts. After controlling for the covariates, on average, Thinking Maps schools had more students achieve proficient or advanced status on the state exam than the other schools in their respective districts (56.21% vs. 51.15%). Thinking Maps schools were 2.72 times more likely to surpass, rather than be surpassed

by, the growth achieved in their district during this time ($p < .001$). Furthermore, after controlling for the covariates, Thinking Maps schools also had more students achieve "advanced" status on the state exam than the other schools in their respective districts (28.30% vs. 25.79%). Here, Thinking Maps schools were 2.00 times more likely to surpass, rather than be surpassed by, the growth achieved in their district during this time ($p < .01$). Put differently, after accounting for the covariates, after two years of program implementation Thinking Maps sites surpassed the mathematics achievement growth of their respective districts 73.12% of the time in terms of the proportion of students achieving proficient/advanced status, and 66.67% of the time in terms of students achieving advanced status.

For third, fourth, and fifth grade, analyses were also conducted that examined the specific impact of the program in each of these grades individually. After controlling for the covariates, analyses found that after two years, Thinking Maps schools were significantly more likely to exceed, rather than be exceeded by, the proficient/advanced rates exhibited in their respective districts in third and fifth grade. In fourth grade, Thinking Maps schools significantly outperformed the district averages in terms of students achieving "advanced" status. Results of the analyses for Year Two are presented in Tables 9-10 and results for each grade level are summarized below.

- ***Third Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved proficient or advanced status than the third graders attending other schools in their respective districts (59.48% vs. 55.14%). Additionally, Thinking Maps third grades were 2.67 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their district during this time ($p < .05$); a finding that was statistically significant.

    - *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps third graders achieved advanced status than those attending the other schools in their respective districts (30.72% vs. 27.54%). Thinking Maps third grades were 2.19 times more likely to surpass, rather than be surpassed by, the growth achieved by the other third grade classes in their districts during this time. This result was not statistically significant.

- ***Fourth Grade***

    - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fourth graders achieved proficient or advanced status than the fourth graders attending the other schools in their respective districts (57.10% vs. 52.42%). Thinking Maps fourth grades were 2.06 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fourth grade classes in their district during this time. This result was not statistically significant.

- *Percent Advanced:* After controlling for the covariates, on average, more Thinking Maps fourth graders achieved advanced status than those attending the other schools in their respective districts (28.94% vs. 26.56%). Thinking Maps fourth grades were 3.13 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fourth grade classes in their district during this time ($p < .05$). This finding was statistically significant.

- ***Fifth Grade***

  - *Percent Proficient or Advanced:* After controlling for the covariates, on average, more Thinking Maps fifth graders achieved proficient or advanced status than the fifth graders attending other schools in their respective districts (54.56% vs. 50.05%). Additionally, Thinking Maps fifth grades were 2.72 times more likely to surpass, rather than be surpassed by, the growth achieved by the other fifth grade classes in their district during this time. This result was calculated as statistically significant ($p < .05$).

  - *Percent Advanced:* After controlling for the covariates, on average, slightly more Thinking Maps fifth graders achieved advanced status than the fifth graders attending the other schools in their respective districts (27.66% vs. 25.68%). However, Thinking Maps fifth grades, by a very slight margin, were more likely to be surpassed by, rather than surpass (0.89), the growth of their respective districts during this time. This result was not calculated to be statistically significant.

Table 9
Treatment Schools and Comparison Districts: Year Two Math

		Treatment Schools M (SE)	Comparison Districts M (SE)
3rd Grade	% Proficient	59.481 (1.570)	55.141 (1.763)
	% Advanced	30.716 (1.298)	27.539 (1.463)
4th Grade	% Proficient	57.097 (1.510)	52.418 (1.714)
	% Advanced	28.939 (1.317)	26.560 (1.500)
5th Grade	% Proficient	54.555 (1.655)	50.046 (1.863)
	% Advanced	27.664 (1.067)	25.677 (1.207)
Overall	% Proficient	56.213 (0.828)	51.153 (0.939)
	% Advanced	28.298 (0.688)	25.785 (0.783)

Note. All percentages are adjusted to account for the covariates included in the analysis (see Analytic Approach section). Standard errors are presented alongside the percentages displayed. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).

Table 10
Logistic Regression Results: Year Two Mathematics

		β	SE	Wald's χ^2	*p*	Odds Ratio
3rd Grade	% Proficient	0.983	0.501	3.850	0.050	2.674
	% Advanced	0.784	0.493	2.530	0.112	2.190
4th Grade	% Proficient	0.721	0.496	2.115	0.146	2.057
	% Advanced	1.141	0.506	5.087	0.024	3.130
5th Grade	% Proficient	1.002	0.491	4.159	0.041	2.724
	% Advanced	-0.112	0.495	0.051	0.821	0.894
Overall	% Proficient	1.000	0.250	16.002	0.000	2.719
	% Advanced	0.691	0.251	7.569	0.006	1.996

Note 1. Percent proficient calculations include students who scored proficient or advanced on the state exams. Overall calculations include all grades (second through eighth).
Note 2. The sample sizes for the analyses were as follows: 3rd Grade: Treatment = 47 schools, Comparison = 38 districts; 4th Grade: Treatment = 48 schools, Comparison = 38 districts; 5th Grade: Treatment = 45 schools, Comparison = 36 districts; Overall: Treatment = 68 schools (170 grade level classes), Comparison = 48 districts (134 grade level comparisons)

Discussion

Taken in combination, the results of the analyses suggest potential benefits of the Thinking Maps program for fostering improved learning in reading and math. Across grades 2nd-8th, schools that used Thinking Maps outpaced the achievement growth exhibited in their districts at a statistically significant frequency. These results appeared after the first and second year of program use in reading and after the second year of use in math. After controlling for demographic characteristics and prior achievement, schools using Thinking Maps were 1.98 (Year One reading; $p < .01$), 1.77 (Year Two reading; $p < .05$), and 2.72 (Year Two math; $p < .001$) times more likely to surpass, rather than be surpassed by, the growth achieved in their respective school districts. In Year Two, Thinking Maps schools also exceeded the growth exhibited in their respective districts at a significant rate in terms of the number of students achieving *advanced* status on the state exams ($p < .01$).

Disaggregated analyses that examined achievement outcomes in specific grade levels also generally favored the performance of Thinking Maps schools, though results were generally not statistically significant. Significant differences did appear in several areas, however. In reading, Thinking Maps schools achieved performance gains that exceeded those of their respective districts at a significant rate in fifth grade after Year One (percent proficient/advanced). In math, Thinking Maps schools significantly outperformed their district counterparts in select areas in third grade (Year Two percent proficient/advanced), fourth grade (Year Two percent advanced), and fifth grade (Year Two percent proficient/advanced).

Although the overall results of this study are promising, more research is needed to buttress its main findings. The analyses conducted in this study involved examining school-level, rather than student-level data and compared the achievement of schools with that of the school districts in which they were housed. Analyses conducted on school-level data, though informative with regard to general achievement trends, treat all students within the school as having the same exposure to a program, and are not sensitive to how implementation factors may influence program outcomes. Further, given that this study relied on obtaining achievement data from state department of education data warehouses, a process that spanned nearly 10 states, it was not possible to equitably create a matched control group in which to compare the achievement of the Thinking Maps schools. Rather, each school's district was used as each school's own counterfactual. Though factors such as school demographics, baseline achievement, and student socio-economic characteristics were controlled for in the analyses, it is possible that other, undocumented differences between the schools and their respective districts were present that were not accounted for.

While considering these limitations, the results of this study reflect a degree of promise with regard to the potential impact of the Thinking Maps program on school reading and math achievement. Across multiple grade levels, Thinking Maps schools were found to outgain their respective districts in the proportion of students achieving proficient or advanced status on state exams in both reading and math. Coupled with future research that examines the program's impact on student-level achievement against a matched comparison group, these findings may be generalized to inform the adoption and future implementation of this program.

Appendix

Table A1

Reading Proficiency: Average Percentage of Students Achieving Proficient or Advanced Levels on State Exams for Thinking Maps Schools and Comparison Districts

	Baseline		Year 1		Year 2	
	TM	District	TM	District	TM	District
2nd	50.4%	57.1%	71.3%	65.7%	68.0%	60.5%
3rd	55.2%	55.6%	52.4%	50.3%	50.9%	50.2%
4th	58.0%	58.8%	52.3%	51.6%	51.8%	50.5%
5th	55.4%	56.6%	55.5%	52.0%	52.4%	50.9%
6th	51.2%	55.5%	57.2%	55.1%	58.0%	53.7%
7th	63.8%	60.4%	53.0%	39.8%	48.5%	37.1%
8th	62.9%	59.8%	45.8%	38.4%	51.2%	39.9%
Overall	56.6%	57.8%	54.5%	52.1%	53.2%	51.2%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of students in each site achieving proficient status and do not include adjustments for any covariates.

Table A2

Reading Advanced: Average Percentage of Students Achieving Advanced Levels on State Exams for Thinking Maps Schools and Comparison Districts

	Baseline		Year 1		Year 2	
	TM	District	TM	District	TM	District
2nd	22.7%	26.0%	42.7%	33.7%	28.5%	25.5%
3rd	24.5%	24.7%	23.5%	21.7%	24.4%	23.2%
4th	29.6%	27.3%	23.8%	22.1%	24.8%	23.3%
5th	25.8%	24.6%	24.4%	21.7%	22.6%	21.3%
6th	17.6%	19.3%	22.6%	19.1%	20.5%	20.0%
7th	24.0%	19.6%	17.8%	7.2%	17.2%	7.3%
8th	33.0%	25.3%	16.2%	8.1%	18.1%	8.8%
Overall	25.9%	25.1%	23.9%	21.5%	23.7%	22.1%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of students in each site achieving advanced status and do not include adjustments for any covariates.

Table A3

Reading Proficiency and Advanced Comparisons: Percentage of Thinking Maps Schools Demonstrating More Growth than their District's Average (Unadjusted Percentages)

	Year 1		Year 2	
	Proficient	Advanced	Proficient	Advanced
2nd	66.7%	66.7%	50.0%	50.0%
3rd	58.7%	55.8%	45.7%	50.0%
4th	46.8%	40.9%	53.2%	34.1%
5th	58.7%	50.0%	55.6%	52.4%
6th	61.1%	50.0%	62.5%	40.0%
7th	100.0%	80.0%	100.0%	60.0%
8th	40.0%	0.0%	80.0%	40.0%
Overall	56.0%	47.3%	55.6%	45.7%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of Thinking Maps sites exceeding the growth of their respective districts and do not include adjustments for any covariates.

Table A4

Math Proficiency: Average Percentage of Students Achieving Proficient or Advanced Levels on State Exams for Thinking Maps Schools and Comparison Districts

	Baseline		Year 1		Year 2	
	TM	District	TM	District	TM	District
2nd	63.3%	65.7%	75.3%	71.7%	76.5%	68.5%
3rd	59.4%	58.4%	55.1%	52.2%	57.0%	53.5%
4th	57.8%	58.2%	53.1%	51.1%	53.4%	51.0%
5th	56.3%	55.9%	52.1%	48.6%	51.8%	47.4%
6th	49.1%	51.6%	51.4%	49.1%	55.0%	46.0%
7th	56.4%	55.2%	42.5%	29.2%	42.7%	31.3%
8th	54.6%	50.8%	36.8%	28.2%	42.4%	35.4%
Overall	57.2%	57.4%	53.1%	50.3%	54.3%	50.2%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of students in each site achieving proficient status and do not include adjustments for any covariates.

Table A5

Math Advanced: Average Percentage of Students Achieving Advanced Levels on State Exams for Thinking Maps Schools and Comparison Districts

	Baseline		Year 1		Year 2	
	TM	District	TM	District	TM	District
2nd	35.3%	35.7%	51.7%	42.0%	51.0%	36.5%
3rd	29.1%	28.3%	26.3%	24.1%	28.5%	24.8%
4th	29.9%	29.5%	25.7%	24.0%	26.5%	24.1%
5th	29.9%	27.8%	26.1%	23.7%	27.1%	23.5%
6th	23.1%	26.0%	25.1%	23.6%	29.9%	23.8%
7th	22.4%	19.9%	19.8%	10.2%	20.5%	11.0%
8th	21.4%	15.8%	17.1%	8.7%	14.9%	11.1%
Overall	28.5%	28.0%	26.0%	23.8%	27.5%	23.9%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of students in each site achieving advanced status and do not include adjustments for any covariates.

Table A6

Math Proficiency and Advanced Comparisons: Percentage of Thinking Maps Schools Demonstrating More Growth than their District's Average (Unadjusted Percentages)

	Year 1		Year 2	
	Proficient	Advanced	Proficient	Advanced
2nd	33.3%	33.3%	100.0%	100.0%
3rd	52.1%	54.5%	58.7%	61.4%
4th	50.0%	47.7%	53.2%	62.2%
5th	55.3%	47.6%	61.4%	50.0%
6th	52.6%	47.1%	76.5%	80.0%
7th	60.0%	60.0%	60.0%	40.0%
8th	40.0%	40.0%	40.0%	20.0%

Overall	52.8%	49.7%	60.2%	59.5%

Note. All percentages displayed are unadjusted. Percentages reflect the actual percentage of Thinking Maps sites exceeding the growth of their respective districts and do not include adjustments for any covariates.

Table A7

Sample Sizes for Main Analyses: Treatment and Comparison Groups

	Treatment Sites	Comparison Districts
Reading Proficiency Year One	68 schools (178 grade level classes)	48 districts (138 grade level comparisons)
Reading Advanced Year One	68 schools (173 grade level classes)	48 districts (135 grade level comparisons)
Reading Proficiency Year Two	68 schools (170 grade level classes)	48 districts (134 grade level comparisons)
Reading Advanced Year Two	68 schools (167 grade level classes)	48 districts (131 grade level comparisons)
Mathematics Proficiency Year One	68 schools (178 grade level classes)	48 districts (138 grade level comparisons)
Mathematics Advanced Year One	68 schools (174 grade level classes)	48 districts (135 grade level comparisons)
Mathematics Proficiency Year Two	68 schools (170 grade level classes)	48 districts (134 grade level comparisons)
Mathematics Advanced Year Two	68 schools (167 grade level classes)	48 districts (131 grade level comparisons)

Table A8

Sample Sizes for Third, Fourth, and Fifth Grade Analyses: Treatment and Comparison Groups

	Treatment Sites	Comparison Districts
3rd Grade		
Reading Proficiency Year One	47	38
Reading Advanced Year One	45	37
Reading Proficiency Year Two	47	38
Reading Advanced Year Two	46	37
Mathematics Proficiency Year One	47	38
Mathematics Advanced Year One	46	37
Mathematics Proficiency Year Two	47	38
Mathematics Advanced Year Two	46	37

4th Grade		
Reading Proficiency Year One	48	38
Reading Advanced Year One	47	37
Reading Proficiency Year Two	48	38
Reading Advanced Year Two	47	37
Mathematics Proficiency Year One	48	38
Mathematics Advanced Year One	46	37
Mathematics Proficiency Year Two	48	38
Mathematics Advanced Year Two	47	37
5th Grade		
Reading Proficiency Year One	47	37
Reading Advanced Year One	46	36
Reading Proficiency Year Two	45	36
Reading Advanced Year Two	44	35
Mathematics Proficiency Year One	47	37
Mathematics Advanced Year One	46	36
Mathematics Proficiency Year Two	45	36
Mathematics Advanced Year Two	44	35