PARTNERSHIP FOR LOS ANGELES SCHOOLS
LEANLAB EDUCATION

ILLUSTRATIVE MATH

RETROSPECTIVE QUASI-EXPERIMENTAL DESIGN STUDY

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PARTNERSHIP FOR LOS ANGELES SCHOOLS

LEANLAB EDUCATION

Illustrative Math Retrospective Quasi-Experimental Design Study

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OVERVIEW

OVERVIEW

EXECUTIVE SUMMARY

IM Math is a problem-based K–12 math program from the nonprofit Illustrative Mathematics (IM) that emphasizes student discourse, conceptual understanding, and coherent learning progressions aligned to rigorous standards. The Partnership for Los Angeles Schools (Partnership), along with the Los Angeles Unified School District, began implementing IM Math in schools in the 2020-21 school year, and expanded implementation to more schools each subsequent year. Partnership and Leading Educators collaborated on the design of curriculum-aligned implementation support and began providing this support and professional learning to select schools implementing IM Math in 2022-23. The present study used a retrospective quasi-experimental design to examine the impact of both IM Math and implementation support on school-level student math achievement.

Findings revealed that school-level math achievement grew at a faster rate over time for schools that implemented IM Math compared with schools that did not implement IM Math. Additionally, schools implementing IM Math showed significant improvement in school-level math outcomes after receiving implementation support, with the impact of that support becoming larger in each successive year.

OVERVIEW

RESEARCH QUESTIONS

Q1 Do schools that use IM Math show greater math achievement compared with schools that do not use IM Math?

Q2 Among schools that use IM Math, do schools with implementation support show greater math achievement compared with schools that do not receive implementation support?

Q2a Do schools that began implementation without implementation support show improvement after receiving support?

Q3 What IM Math implementation features predict higher math achievement?

Q4 Do schools with high implementation integrity have better math achievement than schools with low implementation integrity?

Q5 What IM Math implementation features support implementation integrity?

Q6 What professional learning (PL) opportunities predict higher math achievement?

METHODOLOGY

METHODOLOGY

RESEARCH DESIGN

A retrospective quasi-experimental design was used to examine the impact of IM Math on student outcomes. The study included all schools in LAUSD (n = 760). Of these schools, 465 did not implement IM Math. A total of 295 schools began IM Math implementation between 2020-21 and 2024-25. The total number of schools that began implementing IM Math in each year is presented in Table 1 below.

TABLE 1: Number of schools that began IM Math implementation in each year

Year	Number of Schools that Began IM Math Implementation
2020-21	111
2021-22	75
2022-23	58
2023-24	39
2024-25	19

The decision regarding which schools would implement IM Math was not random, and schools' demographic variables and test scores differed. For example, the average percentage of students meeting or exceeding Smarter Balanced Assessment (SBA) math standards in 2018-19 was 19.7% in non-IM Math schools and 16.0% in schools that would eventually implement IM Math. A matching procedure was used to identify a sample of non-IM Math schools that were most similar to the IM Math schools. Because there were no comparable matches for some schools, the final sample used for analyses of research questions 1 and 2 included 148 schools that began implementation of IM Math between 2020-21 and 2024-25 and 148 schools that did not begin implementation of IM Math in this timeframe. More information on the matching process can be found in the Appendix.

METHODOLOGY

MEASURES

Outcome Measures

The primary outcome measure used for this study was the school-level percentage of students meeting or exceeding standards on the SBA math test in each of the school years including 2021-22, 2022-23, 2023-24, and 2024-25.[1] The SBA is administered to all LAUSD students in grades 3-8 and 11 each spring. SBA results were drawn from public data sources.

IM Math Implementation

IM Math implementation was a binary variable in which 0 = school has not implemented IM Math and 1 = school has implemented IM Math. Information on which schools were implementing IM Math was provided by Partnership.

Implementation Support

Implementation support was measured as a binary variable in which 0 = school has not received implementation support and 1 = school has received implementation support. Additionally, timing of support was a binary variable in which 0 = year(s) after IM Math implementation began but before support began, and 1 = year(s) after support began. Information on which schools received implementation support and in which year support began were provided by Partnership.

IM Math Implementation Features

A number of school-level characteristics were identified as features important for successful IM Math implementation including: classroom culture; IM Math-specific progress monitoring systems; teacher development; coach development; alignment of vision and content; planning and data informed instruction; appointment of math lead; common conference time; release time; observations; and time/funding for PL (more details can be found in the Appendix). All features were rated by Partnership staff in the fall of 2025.

[1] Because of COVID, the SBA was only administered to high school students (grade 11) in 2020-21, so 2021-22 was the first year with complete data after any schools began implementing IM Math.

METHODOLOGY
MEASURES

IM Math Implementation Integrity

Implementation integrity was measured using IM's Implementation Reflection Tool (IRT), which is an observation protocol designed to determine a school's current state of implementation integrity.[2] Three indicators were included in the current study:

- **C1.4 Valuing Student Thinking** measures the extent to which the teacher actively affirms students' mathematical competence; rated on a scale of Emerging, Progressing, Implementing, and Integrating, from lowest to highest.
- **C2.2 Use of IM's Design Structure** measures teacher's use of IM's problem-based design structure and approach; rated on a scale of Emerging, Progressing, Implementing, and Integrating, from lowest to highest.
- **C3.3 Communication of Mathematical Ideas** measures students' ability to explain their reasoning and revise their thinking; rated on a scale of Receiving, Reacting, Interacting, and Belonging, from lowest to highest.

Partnership and Leading Educators staff were trained by IM on using the IRT to observe and score these specific indicators. Observations were conducted multiple times at each school in 2023-24 and 2024-25. Each observation indicator was scored separately. The final variables used in the analyses were: the percentage of observations of C1.4 that met Progressing or better; the percentage of observations of C2.2 that met Progressing or better; the percentage of observations of C3.3 that met Reacting or better; the average across the three indicators; and the change in the average across the three indicators from 2023-24 to 2024-25.

PL Opportunities

Staff at IM Math schools were offered various IM Math-aligned PL opportunities throughout the year. Attendance was taken at each session, and staff members' roles and schools were recorded. For the purposes of this study, attendance was collapsed into binary variables where 0 = no staff at the school attended the PL or 1 = at least one staff person at the school attended the PL. Whether or not administrators, coaches, teachers, or teacher leaders attended PL were recorded as separate variables, and whether or not any staff attended IM Math-specific training, teacher-leader cadre, lesson labs, or coach-focused PL were recorded as separate variables.

[2] It is important to note that the IRT was not designed to be a research instrument. It has not been validated and there are currently no published reliability estimates on the measure.

METHODOLOGY
MEASURES

School-Level Demographics

The school-level percentage of students that were Black, white, Hispanic/Latino, English learners, students with disabilities, and economically disadvantaged were drawn from public data sources for the year 2018-19. This year was chosen for these demographics because it preceded schools implementing IM Math. Demographic variables were grand-mean centered to improve interpretability of the variables.

Other School-Level Covariates

Three other school-level covariates were included in models. School level was coded as elementary (any combination of grades that ends in 6th grade or earlier), secondary (any combination of grades that ends between 8th and 12th grade), or specialized (PreK-12 or K-12 schools). The percent of students meeting or exceeding SBA math standards in 2018-19 was used as the baseline school-level achievement variable because the SBA was not administered in LAUSD in 2019-20 due to COVID. Therefore, 2018-19 is the most recent year with complete data prior to IM Math implementation. This variable was grand-mean centered to improve interpretability. IM Math Cohort indicated the year in which schools began implementing IM.

FINDINGS

FINDINGS
OVERVIEW

- Schools that implemented IM Math showed faster growth in school-level math achievement than schools that did not implement IM Math.
- Schools that implemented IM Math showed improvement in math outcomes after receiving implementation support for IM Math, especially in more recent years, suggesting the impact of support has increased over time.
- Exploratory analyses suggest that IM Math schools with higher implementation integrity may show greater student math outcomes.
- Exploratory analyses suggest that math achievement in IM Math schools had a negative association with common conference time and IM Math-specific PL opportunities for administrators, which may reflect that schools with lower achievement are more likely to implement additional planning structures.

Summary of Analyses

For research questions 1 and 2, analyses were performed on the matched sample of IM Math and non-IM Math schools. Both used a statistical model that allows for testing change across multiple years, and accounts for the fact that the data include multiple years of SBA scores for each school. The models controlled for school-level demographics (% Black students, % English learners, % white students, % students with disabilities, and % economically disadvantaged students), school level (elementary or secondary), IM Math cohort, and the percentage of students that met or exceeded SBA math standards in 2018-19.

Research questions 3 through 6 focus only on the subset of schools that received IM Math implementation support. The subset is smaller, and some schools are missing data on some variables. Therefore, it was not possible to run a statistical model that included all of the control variables with the data. Instead, we examined correlations between the indicators with good variation[3] and the outcome variable of percentage of students meeting or exceeding SBA math standards in 2024-25. These analyses are exploratory and show possible associations between variables, but not whether those associations are due to other variables.

Details about each analysis are included in the Appendix, organized by research question.

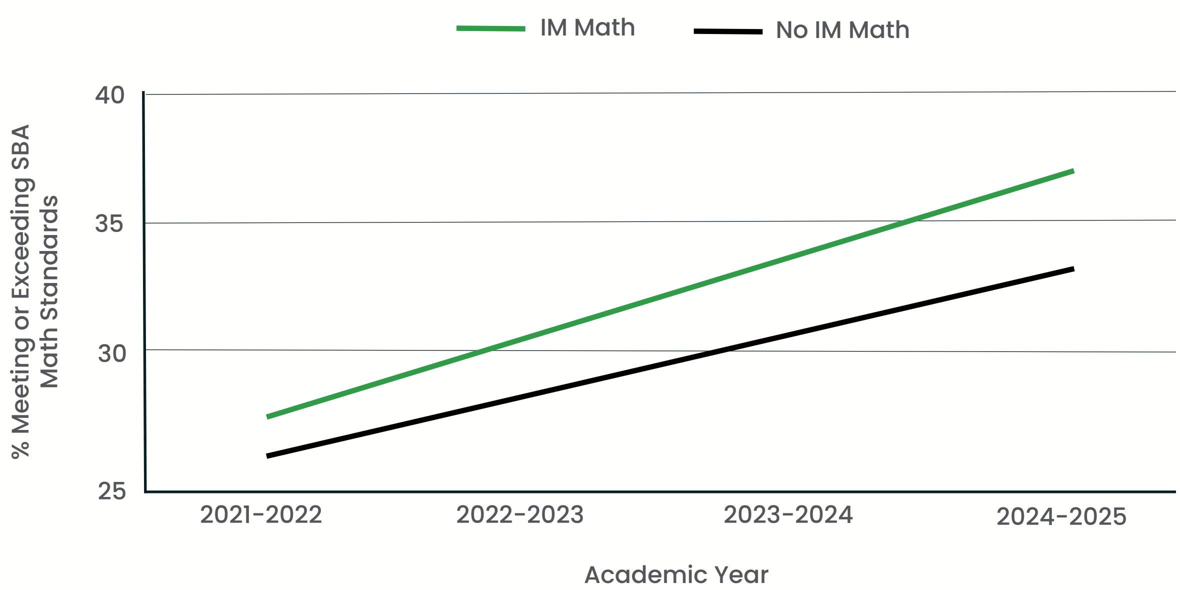
[3] Good variation was defined as at least 6 schools in the “Yes” and “No” group.

Q1 DO SCHOOLS THAT USE IM MATH SHOW GREATER MATH ACHIEVEMENT COMPARED WITH SCHOOLS THAT DO NOT USE IM?

To examine the impact of IM Math on the percentage of students meeting or exceeding SBA math standards, we compared scores over time between schools that implemented IM Math and schools that did not. This analysis included an interaction term between IM Math status and year to examine changes over time in the relationship between IM Math status and the outcome.

Results showed that while all schools grew an average of 2.34 percentage points per year in students meeting or exceeding SBA math standards between 2020-21 and 2024-25, schools that implemented IM Math grew an additional 0.72 percentage points more per year than non-IM Math schools, with an average growth rate of 3.06 percentage points per year. Figure 1 shows the estimated marginal means from the model. These are the average percentages of students meeting or exceeding SBA math standards in each year if all schools had the same demographics, IM Math cohort, school level, and baseline achievement. The 0.72 additional percentage points is roughly equal to an additional three to four months of growth per year for schools implementing IM Math. Between 2021-22 and 2024-25, the average growth in percentage of students meeting or exceeding SBA math standards across all schools in California was 1.31 percentage points per year, further emphasizing the additional growth in math for IM Math schools in LAUSD.

Figure 1: Estimated marginal means from the model predicting school-level math achievement for IM Math and non-IM Math schools



Q2 AMONG SCHOOLS THAT USE IM MATH, DO SCHOOLS WITH IMPLEMENTATION SUPPORT SHOW GREATER MATH ACHIEVEMENT COMPARED WITH SCHOOLS THAT DO NOT RECEIVE IMPLEMENTATION SUPPORT?

For this question, we examined three groups of schools from the matched sample: schools that did not implement IM Math (n = 148), schools that implemented IM Math and did not receive implementation support (n=126), and schools that did receive support (n = 22). This analysis included an interaction term between support and year to see whether there were changes over time in the relationship between receiving support and the outcome.

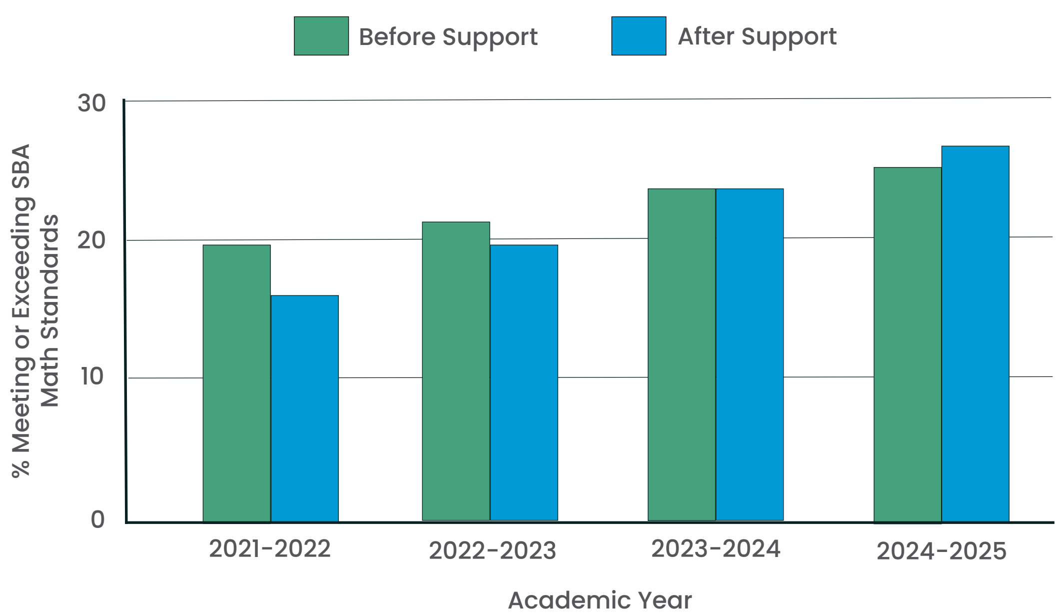
Results showed no differences between schools that implemented IM Math with support and schools that implemented IM Math without support. There may be multiple reasons for this: first, it's possible that Partnership and Leading Educators targeted support at lower-achieving schools, which may also grow more slowly than higher achieving schools; and second, there were only 22 schools in the support group included in the matched sample, which may be too few schools to detect a statistically significant impact.

Q2a DO SCHOOLS THAT BEGAN IMPLEMENTATION WITHOUT SUPPORT SHOW IMPROVEMENT AFTER RECEIVING SUPPORT?

The analysis for research question 2 compared schools that never received implementation support to schools that received at least one year of implementation support between 2021-22 and 2024-25. Another way to assess the impact is to only look at schools that received support and see if their outcomes improved after receiving support. To answer this question, we analyzed all of the schools that received IM Math implementation support (n = 68), and compared those schools' outcomes before and after they began receiving support. We included an interaction term in the statistical model to examine whether or not change in the outcome as a result of receiving support varied depending on the year of the assessment.

Results showed a significant interaction between time and year, suggesting that schools grew at a faster rate after receiving implementation support than before they began receiving support. Figure 2 shows the estimated marginal means from the model. These are the average outcomes when all demographics and other school-level characteristics besides support are held constant.

Figure 2: Estimated marginal means from the model predicting school-level math achievement for schools before and after receiving implementation support

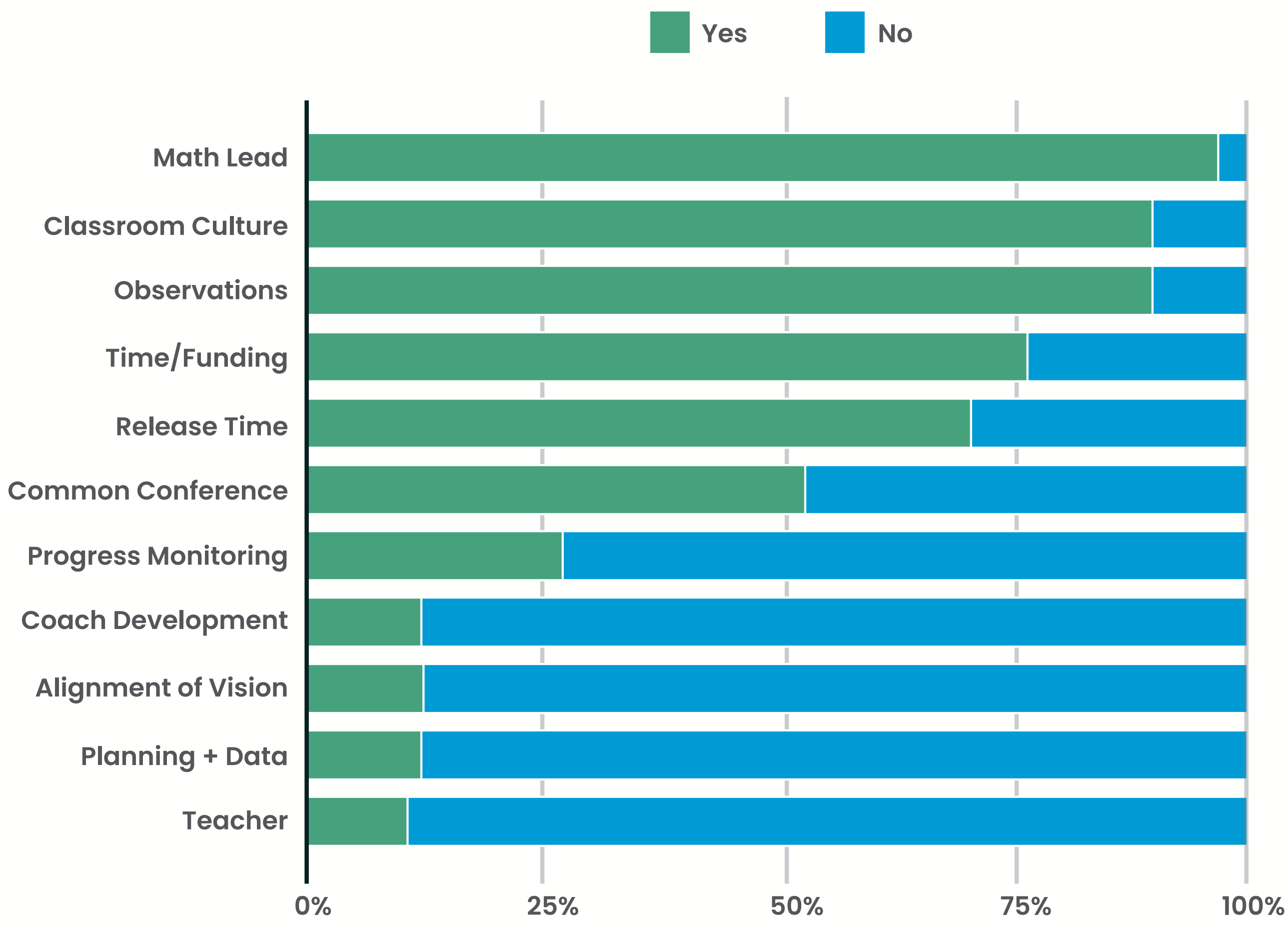


In 2021-22, the first year of Implementation support, schools that had not yet started to receive support scored higher than schools that had started to receive support. (Note: The support only began a few weeks before the SBA was administered.) Therefore, it is unlikely that the support impacted on math achievement. Between 2022-23 and 2024-25, the difference in the outcome between schools that received support and schools that had not yet received support grew, suggesting that implementation support became more impactful over time.

Q3 WHAT IM MATH IMPLEMENTATION FEATURES PREDICT HIGHER MATH ACHIEVEMENT?

A total of 41 schools receiving implementation support were rated on a number of school-level implementation features identified as important for successful IM Math implementation. Most of the implementation features showed very little variation. For example, all but one school had appointed a math lead, and 90% of schools were rated as having a positive classroom culture. Figure 3 below shows the percentage of the 41 schools with "Yes" and "No" for each variable.

Figure 3: Percentage of schools with each of the implementation features



Among the few features with variation, most showed no meaningful association with achievement. One feature—common conference time—showed a negative correlation with achievement ($r = -0.49$, $p < 0.01$), which may reflect that schools with lower achievement are more likely to implement additional planning structures. In fact, because achievement was measured in spring of 2025 and the IM implementation features were measured six months later in fall of 2025, it is possible that schools responded to low achievement by setting up common conference time and that the impact of this additional feature has not yet been measured. However, this is an exploratory analysis and results should not be interpreted as causal.

Q4 DO SCHOOLS WITH HIGH IMPLEMENTATION INTEGRITY HAVE BETTER MATH ACHIEVEMENT THAN SCHOOLS WITH LOW IMPLEMENTATION INTEGRITY?

In 2024-25, observations were conducted an average four times per year with an average of three teachers being observed on each date. Across schools, teachers were observed an average of two times per year. Descriptive statistics for each implementation integrity measure are presented in Table 2 below. On average, schools were meeting implementation integrity thresholds for more than half of the observations, suggesting that schools were successfully meeting implementation integrity standards. However, there was also a lot of variability in these measures, meaning that some schools were not implementing with integrity. Additionally, the average change from 2023-24 to 2024-25 was negative, suggesting that some schools' implementation integrity decreased over time.

TABLE 2: Mean, standard deviation, minimum, and maximum percentage of observations meeting thresholds for each implementation integrity for each of the implementation integrity indicators

Indicator	*n*	Mean %	SD	Minimum	Maximum
Average across indicators	38	64.50	21.14	0.00	0.96
C2.2 Progressing or better	36	65.17	21.58	0.00	1.00
C1.4 Progressing or better	23	74.52	21.74	0.33	1.00
C3.3 Reacting or better	25	58.04	22.89	0.20	1.00
Change in average from 2023-24 to 2024-25	32	-13.38	29.00	-0.92	0.38

Results from the exploratory analysis revealed no significant correlations between the outcome and the implementation integrity indicators. This may be because of the small number of schools. However, there were medium correlations between the outcome and most of the indicators (ranging from r =0.22 to 0.43), suggesting that higher implementation integrity may be associated with better student outcomes. Again, because this is an exploratory analysis, results should not be interpreted as causal.

Q5 WHAT IM MATH IMPLEMENTATION FEATURES SUPPORT IMPLEMENTATION INTEGRITY?

This exploratory analysis examined correlations between the implementation features and the implementation integrity indicators. Results showed a significant correlation between progress monitoring systems and change in implementation integrity from 2023-24 to 2024-25 ($r = 0.40$, $p < 0.05$), suggesting that schools with progress monitoring systems showed better implementation integrity.

Q6 WHAT PL OPPORTUNITIES PREDICT HIGHER MATH ACHIEVEMENT?

Data on staff attendance at PL opportunities were obtained for 41 schools. The majority of schools had a coach and a teacher attend at least one IM Math-aligned PL opportunity. Less than a quarter of schools had a teacher leader attend an IM Math-aligned PL opportunity, and only a third of schools had an administrator attend a PL opportunity. Around 60% of schools had at least one staff member attend a teacher-leader cadre, while just under half of schools had at least one staff member attend the other types of IM Math-aligned PL opportunities.

Results showed a significant negative association between administrators attending PL and the percentage of students meeting or exceeding SBA math standards in 2024-25 ($r = -0.35$, $p < .05$). Schools that had an admin attend at least one PL session scored lower than schools that did not have an admin attend any PL sessions. This may be because the PL sessions are designed for teachers, teacher leaders, and instructional coaches. When an administrator attends a PL session, it is likely that the school does not have a teacher leader or instructional coach available. The lower outcome scores may, in fact, be due to the lack of an instructional coach or teacher leader, and not specifically to the administrator attending PL. Again, this analysis is exploratory and results should not be interpreted as causal.

APPENDIX

APPENDIX
IM MATH IMPLEMENTATION

The IM Math implementation features include conditions believed to support successful implementation of IM Math at a school. The features examined in this study include:

- **Classroom Culture:** Teachers build positive, trusting relationships with students and classroom set ups to encourage student conversation.
- **Progress Monitoring Systems:** School leadership team sets up structures and processes to observe progress and provide feedback.
- **Teacher Development:** School leadership team executes a sustained PL plan to support IM Math implementation.
- **Coach Development:** Administrators set up systems and processes to support teacher leaders and instructional coaches as integral parts of the school leadership team.
- **Alignment of Vision and Content:** Teachers are committed to implementing IM Math with integrity and ensuring lessons are aligned with IM Math content.
- **Planning and Data Informed Instruction:** Teachers plan lessons using student data.
- **Math Lead:** School has appointed a math lead.
- **Common Conference:** Teachers have a common conference time for planning and facilitation.
- **Release Time:** Teacher leaders and/or instructional coaches have release time to allow them to support teachers in implementing IM Math.
- **Observations:** Classroom observations are conducted regularly.
- **Time/Funding:** School has dedicated time and adequate funding for teacher collaboration and PL.

APPENDIX

MATCHING

To create comparable IM Math and non-IM Math groups, we used propensity score matching using the MatchIt package in R. After removing observations with missing data on key variables (baseline achievement, school demographic characteristics, school level, and IM Math status), we used nearest neighbor matching with a 1:1 ratio. Schools were matched based on their 2018-19 percentage of students meeting standards, with propensity scores estimated using logistic regression. To ensure developmental appropriateness, we required exact matching on school level. IM Math schools were only matched to non-IM Math schools serving the same grade configuration. We imposed a caliper of 0.25 standard deviations on the propensity score to prevent poor matches, and matching was conducted without replacement to ensure each control school was used only once. Table A1 below summarizes the IM Math and non-IM Math groups before and after matching.

APPENDIX

MATCHING

TABLE A1: Means and standard deviations for schools that did not implement IM Math and schools that did implement IM Math and differences between groups in standard deviation units both before and after matching

Variable	Before Matching			After Matching		
	IM Math n=295	No IM Math n=465		IM Math n=148	No IM Math n=148	
	Mean (SD)	Mean (SD)	Diff.	Mean (SD)	Mean (SD)	Diff.
% Students meeting SBA standards 2018-19	16.0 (7.7)	19.7 (8.2)	0.47	18.4 (7.3)	18.9 (7.1)	0.07
% Black students	9.0 (13.9)	8.8 (13.8)	0.11	9.0 (14.1)	9.0 (13.7)	0.00
% White students	6.9 (10.8)	11.6 (17.6)	0.31	7.53 (11.0)	10.4 (15.3)	0.21
% Hispanic/Latino students	77.94 (21.86)	71.48 (26.45)	0.26	75.78 (22.53)	71.54 (25.27)	0.18
% English Learners	22.2 (14.3)	24.6 (16.0)	0.15	25.3 (16.4)	22.1 (16.8)	0.20
% Economically Disadvantaged	87.3 (17.5)	80.4 (24.0)	0.31	84.6 (19.5)	81.1 (21.9)	0.17
% Students with Disabilities	14.3 (5.3)	12.9 (6.2)	0.24	13.6 (5.7)	13.0 (4.9)	0.12

APPENDIX

STATISTICAL ANALYSES

1. Do schools that use IM Math show greater math achievement compared with schools that do not use IM Math?

The linear mixed effects model was conducted using the lme4 package in R. The model included:

- Fixed effects for IM Math implementation, year of assessment, percent of students meeting/exceeding SBA standards for math in 2018-19 (baseline, pre-COVID), school level (elementary or secondary), IM Math Cohort, and school-level demographics.
- Interaction between IM Math implementation and year of assessment.
- Random intercepts for repeated observations within the same school across years.

Results revealed a significant positive interaction between IM Math and year ($t(878) = 2.99$, $p = .003$), indicating that IM Math schools experienced significantly greater growth in math proficiency per year compared with non-IM Math schools, even after controlling for school demographic composition and prior achievement. Specifically, IM Math schools gained approximately 0.72 percentage points more per year than non-IM Math schools.

Table A2 below shows the fixed effects from the model and Table A3 shows the random effects variance components.

APPENDIX

STATISTICAL ANALYSES

TABLE A2: Fixed effects from linear mixed effects model predicting percent of students meeting or exceeding SBA math standards over time

Fixed Effect	Estimate	SE	df	t-value	p-value	95% CI
(Intercept)	29.87	0.93	332.25	31.97	<0.001	[28.04,31.70]
IM Math	1.68	1.78	308.96	0.94	n.s.	[-1.81,5.16]
Year	2.34	0.17	878.15	13.60	<0.001	[2.00,2.67]
IM Math x Year	0.72	0.24	878.14	2.99	0.003	[0.25,1.20]
% Black	-0.15	0.04	283.99	-3.56	<0.001	[-0.23,-0.07]
% English Learner	-0.08	0.05	284.09	-1.47	n.s.	[-0.19,0.03]
% White	-0.07	0.08	283.94	-0.84	n.s.	[-0.23,0.09]
% Students with Disabilities	-0.35	0.10	284.68	-3.37	<0.001	[-0.55,-0.14]
% Economically Disadvantaged	-0.51	0.06	283.97	-7.87	<0.001	[-0.63,-0.38]
% Met/Exceeded 2018-19	0.55	0.09	284.53	5.94	<0.001	[0.37,0.73]
Secondary Schools	-8.27	1.63	284.05	-5.06	n.s.	[-11.48,-5.07]
IM Math Cohort	-1.09	0.78	284.29	-1.39	n.s.	[0.25,1.20]

n.s. Non-significant at $p < .05$.

APPENDIX
STATISTICAL ANALYSES

TABLE A3: Random effects variance components

Random Effect	Variance	S.D.
School (Intercept)	68.12	8.25
Residual	21.46	4.63

Model Summary

- **Formula:** %metSBA ~ IM Math * year + %Black + %EL + %White + %SWD + %ED + %metSBA2019 + Secondary + IM Math Cohort + (1 | School)
- **Observations:** 1,174
- **Groups:** 294 schools
- **AIC:** 7737.22, **BIC:** 7808.18
- **Marginal R^2:** 0.72, **Conditional R^2**: 0.93

APPENDIX
STATISTICAL ANALYSES

2. Among schools that use IM Math, do schools with implementation support show greater math achievement compared with schools that do not receive implementation support?

The linear mixed effects model was conducted using the lme4 package in R. The model included:

- Fixed effects for support, year of assessment, percent of students meeting/exceeding SBA standards for math in 2018-19 (baseline, pre-COVID), school level (elementary or secondary), IM Math cohort, and school-level demographics.
- Interaction between support and year of assessment.
- Random intercepts for repeated observations within the same school across years.

Results revealed no significant differences between schools that implemented IM Math with support and schools that implemented IM Math without support.

Table A4 below shows the fixed effects from the model and Table A5 shows the random effects variance components.

APPENDIX

STATISTICAL ANALYSES

TABLE A4: Fixed effects from linear mixed effects model predicting percent of students meeting or exceeding SBA math standards over time

Fixed Effect	Estimate	SE	df	t-value	p-value	95% CI
(Intercept)	31.71	1.57	301.25	20.16	<0.001	[28.63,34.79]
Support: No IM Math	-1.62	1.78	310.17	-0.91	n.s.	[-5.10,1.87]
Support: Yes w/IM Math	3.15	2.31	345.60	1.36	n.s.	[-1.39,7.69]
Year	3.06	0.19	877.17	16.52	<0.001	[2.70,3.42]
Support: No IM Math x Year	-0.73	0.25	877.16	-2.87	0.004	[-1.22,-0.23]
Support: Yes w/IM Math x Year	-0.02	0.48	877.02	-0.03	n.s.	[-0.95,0.92]
% Black	-0.15	0.04	282.98	-3.67	<0.001	[-0.23,-0.07]
% English Learner	-0.09	0.05	283.06	-1.64	n.s.	[-0.20,0.02]
% White	-0.07	0.08	282.95	-0.89	n.s.	[-0.24,0.09]
% Students with Disabilities	-0.36	0.10	283.73	-3.49	<0.001	[-0.56,-0.16]
% Economically Disadvantaged	-0.50	0.06	282.97	-7.97	<0.001	[-0.63,-0.38]
% Met/Exceeded 2018-19	0.54	0.09	283.52	5.89	<0.001	[0.36,0.72]
Secondary Schools	-8.94	1.70	282.98	-5.27	<0.001	[-12.26,-5.61]
IM Math Cohort	-1.30	0.79	283.37	-1.64	n.s.	[-2.85,0.26]

n.s. Non-significant at $p < .05$.

APPENDIX

STATISTICAL ANALYSES

TABLE A5: Random effects variance components

Random Effect	Variance	S.D.
School (Intercept)	67.85	8.24
Residual	21.48	4.64

Model Summary

- **Formula:** %metSBA ~ support * year + %Black + %EL + %White + %SWD + %ED + %metSBA2019 + Secondary + IM Math Cohort + (1 | School)
- **Observations:** 1,174
- **Groups:** 294 schools
- **AIC:** 7735.42, **BIC:** 7816.52
- **Marginal R^2**: 0.72, **Conditional R^2**: 0.93

APPENDIX
STATISTICAL ANALYSES

2a. Do schools that began implementation without support show improvement after receiving support?

The linear mixed effects model was conducted using the lme4 package in R. The model included:

- Fixed effects for after support, year of assessment, percent of students meeting/exceeding SBA standards for math in 2018-19 (baseline, pre-COVID), school level (elementary or secondary), IM Math cohort, and school-level demographics.
- Interaction between time and year of assessment.
- Random intercepts for schools to account for repeated observations within the same school across years.

Results revealed a significant interaction between after support and year ($t(170.61) = 3.44$, $p < .001$), indicating that among schools that received implementation support for IM Math implementation, the percentage of students meeting or exceeding SBA math standards was significantly higher after receiving support than it had been before receiving support. Specifically, once schools started receiving support, they grew by an additional 1.65 percentage points above the baseline yearly trend, suggesting that supported schools grew faster over time than they had been growing before receiving support.

Table A6 below shows the fixed effects from the model and Table A7 shows the random effects variance components.

APPENDIX
STATISTICAL ANALYSES

TABLE A6: Fixed effects from linear mixed effects model predicting percent of students meeting or exceeding SBA math standards over time

Fixed Effect	Estimate	SE	df	t-value	p-value	95% CI
(Intercept)	27.97	5.47	56.93	5.11	<0.001	[17.24,38.70]
After Support	-3.27	0.86	172.95	-3.82	<0.001	[-4.95,-1.59]
Year	1.84	0.41	174.89	4.48	<0.001	[1.03,2.64]
After Support x Year	1.65	0.48	170.67	3.44	<0.001	[0.71,2.60]
% Black	-0.08	0.06	59.30	-1.35	n.s.	[-0.21,0.04]
% English Learner	-0.17	0.10	59.37	-1.60	n.s.	[-0.37,0.04]
% White	-0.09	0.09	57.87	-0.97	n.s.	[-0.28,0.09]
% Students with Disabilities	-0.49	0.18	58.46	-2.64	0.01	[-0.85,-0.13]
% Economically Disadvantaged	-0.52	0.08	58.40	-6.78	<0.001	[-0.67,-0.37]
% Met/Exceeded 2018-19	0.71	0.14	57.54	4.94	<0.001	[0.43,1.00]
Secondary Schools	-3.11	5.69	56.96	-0.55	n.s.	[-14.26,8.04]
IM Math Cohort	-1.52	0.62	62.87	-2.45	0.02	[-2.74,-0.31]

n.s. Non-significant at $p < .05$.

APPENDIX

STATISTICAL ANALYSES

TABLE A7: Random effects variance components

Random Effect	Variance	S.D.
School (Intercept)	23.49	4.85
Residual	8.95	2.99

Model Summary

- **Formula:** %metSBA ~ AfterSupport * year + %Black + %EL + %White + %SWD + %ED + %metSBA2019 + Secondary + IM Math Cohort + (1 | School)
- **Observations:** 237
- **Groups:** 68 schools
- **AIC:** 1375.46, **BIC:** 1424.02
- **Marginal R^2**: 0.81, **Conditional R^2**: 0.95

APPENDIX

STATISTICAL ANALYSES

3. What IM Math implementation features predict higher math achievement?

TABLE A8: Count and percentage of schools with each implementation feature present or absent

Implementation Feature	No n(%)	Yes n(%)
Classroom Culture	4 (9.7)	37 (90.2)
Progress Monitoring Systems	*30 (73.2)*	*11 (26.8)*
Teacher Development	37 (90.2)	4 (9.8)
Coach Development	36 (87.8)	5 (12.2)
Alignment of Vision + Content	36 (87.8)	5 (12.2)
Planning + Data informed	36 (87.8)	5 (12.2)
Math Lead	1 (2.4)	40 (97.6)
Common Conference	*20 (48.8)*	*21 (51.2)*
Release Time	*12 (30.0)*	*28 (70.0)*
Observations	4 (9.8)	37 (90.2)
Time/Funding	*10 (24.4)*	*31 (75.6)*

Note: Italicized rows, where there are at least 6 schools in each group, are included in the exploratory analyses.

TABLE A9: Correlations between implementation features and math outcome

Implementation Feature	*df*	Correlation with % students meeting SBA math standards 2024-25
Progress Monitoring Systems	39	-0.02
Common Conference	39	-0.49**
Release Time	38	0.06
Time/Funding	39	-0.05

** $p < .01$

APPENDIX

STATISTICAL ANALYSES

4. Do schools with high implementation integrity have better math achievement

TABLE A10: Correlations between implementation integrity indicators and math outcomes

Indicator	*df*	Correlation with % students meeting SBA math standards 2024-25
Average across indicators	36	0.10
Change in average from 2023-24	30	0.14
C2.2 Progressing or better	34	-0.02
C1.4 Progressing or better	21	0.31
C3.3 Reacting or better	22	0.25

5. What IM Math implementation features support implementation integrity?

TABLE A11: Correlations between IM Math implementation features (columns) and implementation integrity indicators (rows)

Indicator	Progress Monitoring Systems *r* *df*	Common Conference *r* *df*	Release Time *r* *df*	Time/Funding *r* *df*
Average across indicators	0.19 33	0.06 33	0.11 32	0.04 33
C2.2 Progressing or better	0.26 32	0.14 32	-0.04 31	-0.11 32
C1.4 Progressing or better	0.06 19	-0.23 19	0.13 18	0.05 19
C3.3 Reacting or better	-0.08 21	-0.09 21	0.19 21	0.28 21
Change in average 2023-24 to 2024-25	0.35* 27	-0.02 27	0.00 27	-0.05 27

* $p < .05$

APPENDIX
STATISTICAL ANALYSES

6. What PL opportunities predict higher math achievement ?

TABLE A12: Count and percentage of schools with at least one staff member attending PL opportunities

PL Opportunity	No *n(%)*	Yes *n(%)*
Administrators - All Types PL	29 (70.73)	12 (29.27)
Coaches - All Types PL	19 (46.34)	22 (53.66)
Teachers - All Types PL	19 (46.34)	22 (53.66)
Teacher Leaders - All Types PL	10 (24.39)	31 (75.61)
IM Math-specific training - All Roles	21 (51.22)	20 (48.78)
Cadre PL - All Roles	16 (39.02)	25 (60.98)
Lesson Lab PL - All Roles	23 (56.10)	18 (43.90)
Coach - All Roles	21 (51.22)	20 (48.78)

TABLE A13: Correlations between attendance at PL opportunities and math outcomes

PL Opportunity	*df*	Correlation with % students meeting SBA math standards 2024-25
Administrators - All Types PL	39	-0.32*
Coaches - All Types PL	39	0.00
Teachers - All Types PL	39	-0.05
Teacher Leaders - All Types PL	39	0.11
IM Math-specific training - All Roles	39	0.22
Cadre PL - All Roles	39	0.01
Lesson Lab PL - All Roles	39	-0.13
Coach - All Roles	39	-0.06

* $p < .05$