Impact Evaluation of Imagine Learning Illustrative Mathematics in Fort Zumwalt School District

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Program Description

Imagine Learning's Illustrative Mathematics (IL Illustrative Math) is a problem-based core curriculum for K–12 students. It is designed to be used in face-to-face instruction in student-led whole group instruction. Per the developer, "Illustrative Mathematics (IM) is a K–12® core curriculum designed to give all students equity and access to grade-level mathematics—ensuring each student is an active participant in their learning. IL Illustrative Math is a problem-based curriculum that is designed to provide conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and a productive disposition. Students learn by doing, working their way through problems in both mathematical and real-world contexts and constructing arguments using precise language."

Research Design

Imagine Learning contracted with the Center for Research and Reform in Education (CRRE) at Johns Hopkins University to conduct a quasi-experimental design (QED) in the Fort Zumwalt School District (FZSD) in O'Fallon, MO. FZSD is the largest school district in St. Charles County, serving approximately 18,500 students in 16 elementary, four middle, and four high schools. Grade-level teachers in elementary and middle schools were given the option of implementing IL Illustrative Math in the 2022–23 school year. At the elementary school level (Grades K–5), participation counts across the 16 schools were 149 classrooms in the intervention group and 147 in the comparison (business-as-usual) group. Nearly all grades and schools across the 16 elementary schools contained a mix of classrooms that used or did not use IL Illustrative Math, providing for an ideal comparison group and eliminating potential confounding variables. At the middle school level, considerably larger numbers of classrooms used IL Illustrative Math, especially in Grade 6, where nearly all classrooms used the program. Thus, elementary classrooms were analyzed separately from middle school classrooms, and Grade 6 students were only analyzed descriptively, as nearly 95% of students participated in using IL Illustrative Math.

The evaluation also examined teachers' perceptions of IL Illustrative Math through an online teacher questionnaire. Teachers were asked about topics including instructional practices, IL Illustrative Math curriculum implementation, professional development, and student impact. Likert-scale items were used to collect data relating to teachers' perceptions of IL Illustrative Math. Additionally, four open-ended queries provided teachers with the opportunity to describe curriculum use including any

deviations they made and advice they would offer to teachers new to IL Illustrative Math.

Study Sample

The present study sample included 6,476 Grades 3–8 students across 16 elementary schools and four middle schools. The vast majority of students (around 85% in both conditions) were White. Teacher questionnaire data were collected from 227 teachers and administrators.

Program Impact on Mathematics Achievement

A significant positive impact of IL Illustrative Math on student mathematics achievement was observed for middle school students in Grades 7 and 8. Treatment students who received the IL Illustrative Math program made nearly 16-point larger gains on the Galileo Comprehensive Assessment System (GCAS) mathematics scores from beginning-of-year (BOY) to end-of-year (EOY) of the 2022–23 school year than did comparison students. In addition, special education students in middle school significantly outgained their special education comparison counterparts from BOY to EOY. Significant positive IL Illustrative Math impacts were also observed for Grades 4 and 5 students on the Missouri Assessment Program (MAP) mathematics assessment, with treatment (IL Illustrative Math) students outscoring comparison students by nearly 11 points. As with middle school GCAS scores, special education students in elementary school significantly outgained their special education comparison counterparts on the MAP mathematics assessment by 13 points from spring 2022 to spring 2023.

Teacher Perceptions

Teacher perceptions of IL Illustrative Math were generally very positive, especially regarding perceptions of program impacts on multiple aspects of student learning in math, with more than 90% of program teachers agreeing that the curriculum:

- appropriately challenged students during math instruction
- led to student engagement in high-level discussions during math instruction
- improved students' ability to work in groups
- improved students' ability to problem solve mathematically

Program teachers also expressed very positive overall perceptions of IL Illustrative Math, with nearly 90% of teachers agreeing that they would recommend the program to other teachers. Teacher perceptions of professional development were generally positive, although agreement was slightly lower for the digital tools and resources versus the other curriculum components. Overall, teachers generally

perceived the curriculum very positively, but they were sometimes challenged to implement all features of the program during their allocated math blocks.

Impact Evaluation of Imagine Learning Illustrative Math in Elementary and Middle School Classes

Imagine Learning contracted with the Center for Research and Reform in Education (CRRE) at Johns Hopkins University to conduct a quasi-experimental design (QED) in the Fort Zumwalt School District (FZSD) in O'Fallon, MO. FZSD is the largest school district in St. Charles County, serving approximately 18,500 students in 16 elementary, four middle and four high schools. Grade-level teachers in elementary and middle schools were given the option of implementing IL Illustrative Math in the 2022–23 school year. At the elementary school level (Grades K–5), participation counts across the 16 schools were 149 classrooms in the intervention group and 147 in the comparison (business-as-usual) group. In middle school, nearly all Grade 6 classrooms implemented IL Illustrative Math, while three of four schools used IL Illustrative Math in Grade 7. Grade 8 contained a mix of treatment and comparison students across all four FZSD middle schools. In only three of the 16 elementary schools did all grades and classes use one treatment, specifically here, the intervention. The remainder had mixed treatment participation across grades, thereby eliminating contextual confounding risks. It is important to note that classrooms that implemented IL Illustrative Math were doing so for the first time.

IL Illustrative Math is a problem-based core curriculum for K–12 students. It is designed to be used in face-to-face instruction in student-led whole group instruction. Per the developer, "Illustrative Mathematics is a K–12® core curriculum designed to give all students equity and access to grade-level mathematics—ensuring each student is an active participant in their learning. IL Illustrative Math is designed to provide conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and a productive disposition. Students learn by doing, working their way through problems in both mathematical and real-world contexts and constructing arguments using precise language."

The evaluation's design addressed the following research questions:

1) How does participation in IL Illustrative Math impact student achievement in mathematics?
    a) Does level of program usage relate to student achievement effects?
    b) To what degree do effects vary across:
        i) Schools
        ii) Grade levels
        iii) Student subgroups (ethnicity, ELL, SPED, FARMS)
2) What are teachers' perceptions of the IL Illustrative Math program with regard to:
    a) Benefits for students?
    b) Student engagement?
    c) Implementation requirements?

d) Strengths and weaknesses?
e) Recommendations for implementation improvement?

Method

Research Design

The current study used a quasi-experimental design (QED) in 20 schools in the Fort Zumwalt School District (FZSD) in O'Fallon, MO. FZSD is the largest school district in St. Charles County, serving approximately 18,500 students in 16 elementary, four middle and four high schools. Grade-level teachers in elementary and middle schools were given the option of implementing IL Illustrative Math in the 2022–23 school year. Nearly 6,000 students comprised the overall analytic sample, which is described in more detail below.

Qualitative data were collected through an online teacher questionnaire that was administered to all intervention teachers. Likert-scale questionnaire items were analyzed descriptively, while open-ended responses were analyzed using qualitative analytic techniques (Miles, Huberman, & Saldana, 2002).

Participants

Quantitative sample. Grades 3–8 students were included in quantitative achievement analyses if they had non-missing pretest (BOY) and posttest (EOY for Grades 3–5, MOY for Grades 6–8) Galileo scores (see description below), as well as demographic data. As Grades 3–5 students and Grades 6–8 students were considered as distinct analytic samples, we present demographic breakdowns of treatment and comparison samples by analytic sample in Table 1.

Table 1

Student Demographics (Percentages), by Grade Range

Subgroup	Treatment	Comparison
Grades 3–5		
Female	47.28	48.67
White	84.90	85.30
Black	7.15	7.40
Hispanic	5.01	7.03
Asian	4.97	4.25
Other Race	2.98	3.05
SPED	17.35	14.64
ELL	5.54	5.77
FARMS	19.07	20.41

N	1510	1837
Grades 6–8		
Female	49.00	46.10
White	83.76	84.00
Black	7.91	12.57
Hispanic	6.80	7.05
Asian	4.76	0.57
Other Race	3.57	2.86
SPED	9.98	34.86*
ELL	6.57	2.77
FARMS	18.82	25.71
N	2604	525

Note. * $p < .05$.

Elementary (Grades 3–5) students were very similar on nearly all demographic variables, with only small discrepancies observed in percentages of Hispanic and SPED students. Middle school (Grades 6–8) students were considerably different in terms of special education, with a much larger percentage (35%) of comparison students identified as needing special education services, in relation to only 10% of treatment students. The middle school comparison group also contained larger but not significantly different proportions of free and reduced meals students (FARMS). It is important to note that, while the elementary sample size is relatively evenly split between treatment and comparison, a vast majority of the middle school sample (83%) received IL Illustrative Math. This was expected, as all Grade 6 classrooms and nearly all Grade 7 classrooms were initially expected to use IL Illustrative Math at the beginning of the school year.

Teacher sample. A total of 250 treatment teachers across Grades K–8 in 16 elementary schools and four middle schools were invited to complete the questionnaire and were offered an incentive in the form of a $15 gift card for their participation. A total of 227 participants completed the questionnaire, yielding an extremely high 90.8% response rate. Most participants were classroom teachers, with smaller numbers of special education teachers, instructional coaches, and school principals providing feedback.

Measures

Data sources for the current study include Galileo Comprehensive Assessment System mathematics scores from the 2022–23 school year, along with Missouri Assessment Program mathematics scores from the spring of both 2022 and 2023, and demographic data provided by FZSD. Teacher data included Likert-scale questionnaire items relating to perceptions of the IL Illustrative Math program, as well as free-response and binary-choice items.

Galileo Comprehensive Assessment System Data. Imagine Learning provided CRRE with GCAS mathematics score data from the BOY, MOY, and EOY of the 2022–23 school year for all FZSD Grades 3–8 students. The GCAS was created by Assessment Technology Incorporated (ATI)[1] and is designed for Grades K–12 students. The GCAS is a computer-administered progress-monitoring assessment in English Language Arts (ELA), mathematics, and science. The GCAS can be administered up to three times a year, although FZSD administered the GCAS only at BOY and EOY for elementary students, while administering the GCAS at all three timepoints to middle school students. It is important to note that the EOY GCAS assessment administered by FZSD is more cumulative in nature than the BOY and MOY tests for middle school grades, differing from the original design of the assessments. Thus, EOY scores may have slightly different interpretations than BOY and MOY scores for middle grades. Further, Imagine Learning and FZSD reported variation in how the EOY assessment was administered, especially in terms of content coverage. After discussion with Imagine Learning and FZSD, the decision was made to use MOY GCAS scores as the outcome variable for middle school analyses, while using EOY GCAS scores as the outcome variable for elementary school analyses.

Missouri Assessment Program. FZSD provided CRRE with spring 2022 and 2023 Missouri Assessment Program (MAP) mathematics scores. According to the Missouri Department of Elementary and Secondary Education[2], the MAP is designed to measure how well students acquire the skills and knowledge described in the Missouri Learning Standards (MLS). The MAP is administered in the spring of each school year to students in Grades 3–8 in ELA and mathematics, with the science MAP assessment administered to Grades 5 and 8 students. The MAP mathematics assessment is administered in a secure online format over the course of three sessions. MAP scores are vertically scaled, meaning that scores from students in different grades can be directly compared. In the 2022–23 school year, MAP mathematics scores ranged from 185–660. Spring 2023 MAP mathematics scores were used as outcome variables in impact analyses, while spring 2022 MAP mathematics scores were used as a prior mathematics achievement variable.

Demographics and rostering. FZSD provided CRRE with demographic and rostering data from the 2022–23 school year. Demographic variables included student grade level, ethnicity, gender, Individualized Education Program (IEP) status and codes, language spoken at home (other than English was classified as English language learner (ELL)), race, and FARMS. Rostering data were supplied at BOY, MOY, and EOY for elementary and middle school students. These lists were checked for potential condition movement among students. As minimal condition mobility was observed, rostering data from the same time point as outcome variable collection (i.e., EOY for elementary

[1] Imagine Learning recently acquired ATI. The GCAS system is now a part of Imagine Learning. Imagine Learning has not completed any alignment efforts at the time of this report.
[2] https://dese.mo.gov/special-education/effective-practices/student-assessments/missouri-assessment-program.

students and MOY for middle school students) were used for condition assignment purposes.

Teacher questionnaire. The teacher questionnaire was administered to teachers of IL Illustrative Math students in the 2022–23 school year. The questionnaire included curriculum-specific questions relating to classroom practices, student motivation and achievement, program implementation and usage, professional development and training, and overall program perceptions. The questionnaire contained Likert-scale and yes/no questions, along with four open-ended items. Likert-scale questionnaire responses were analyzed using descriptive statistics (e.g., percentages and counts), while open-ended questionnaire responses were analyzed qualitatively. A copy of the teacher questionnaire can be found in Appendix A.

Analytical Approach

Hierarchical Linear Modeling (HLM) was used to examine the impact of IL Illustrative Math on student math achievement gains. As discussed earlier, elementary and middle school grades were considered separately due to differences in program implementation, as well as available outcome data. In addition, the middle school analytic sample for these analyses consisted of only Grades 7–8, as Grade 6 was comprised of 95% treatment students. Baseline equivalence was met for the elementary sample, with a standardized mean difference of 0.04 SDs. Baseline equivalence was also met with the middle school (Grades 7–8) sample, with a standardized mean difference of 0.12 SDs. No statistical matching techniques were used in these analyses, given the fulfillment of the baseline equivalence requirement, as well as sampling limitations, especially in the middle school grades. Full baseline equivalence tables can be found in Appendix B. As described earlier, for the GCAS mathematics assessment, EOY scores were considered the outcome variable of interest for elementary students, while MOY scores were considered the outcome variable of interest for middle school students. Thus, two sets of analyses were conducted for the GCAS: one each for elementary and middle school samples. Similarly, spring 2023 MAP mathematics scores were considered the outcome variables for MAP analyses, with spring 2022 MAP mathematics scores used as the prior achievement control. The analytic approach for the main impact analyses was the same across elementary and middle grades, and for both GCAS and MAP analyses.

Achievement Results

We begin by descriptively examining Grade 6 scores, which were not included in the impact analyses due to nearly all Grade 6 students receiving the IL Illustrative Math program. Analyses examining the impacts of IL Illustrative Math on GCAS and MAP mathematics scores in other grades follow. Subgroup analyses were also conducted examining IL Illustrative Math's impacts on student subgroups of interest.

Grade 6 descriptives. A total of 1,068 of the 1,115, or 95.8% of Grade 6 students with non-missing BOY and MOY GCAS mathematics scores participated in IL Illustrative Math in the 2022-23 school year. For this reason, we limited our analyses of Grade 6 students to descriptive trend analyses. Table 2 shows average BOY and MOY GCAS and MAP mathematics scores for IL Illustrative Math and comparison Grade 6 students.

Table 2

Grade 6 GCAS and MAP Mathematics Scores

	BOY	MOY	*N*	Growth
GCAS				
IL Illustrative Math	1069.67 (75.44)	1153.75 (80.71)	1,068	84.08
Comparison	972.36 (66.54)	1007.64 (81.47)	47	35.28
MAP				
IL Illustrative Math	413.28 (30.44)	425.46 (30.33)	1,037	12.18
Comparison	334.98 (33.63)	361.98 (35.33)	47	27.00

Note. SD in parentheses.

On the GCAS, IL Illustrative Math students gained approximately 84 points from BOY to MOY, in relation to comparison students, who averaged about 35-point gains. This represents a considerable advantage for the IL Illustrative Math condition, as gains in this condition were nearly 50 points larger than those for comparison students. The pattern was reversed for the MAP assessment, though, with comparison students outgaining IL Illustrative Math students by nearly 15 points. However, with such a small number of comparison students present in Grade 6, and with comparison students having BOY scores more than 1 standard deviation lower than that for treatment students on both assessments, these trends should be interpreted with considerable caution. Full descriptive tables across all grades can be found in Appendix C.

Impact on Elementary Student Mathematics Achievement

In this section, we discuss the results of the main impact analyses examining the effect of IL Illustrative Math on elementary mathematics achievement, as measured by the GCAS and MAP assessments. We will also examine the results of subgroup analyses on both outcome measures.

Impact analyses. Table 3 shows the results of the analyses examining the impact of IL Illustrative Math on EOY GCAS mathematics scores. Hierarchical linear modeling (HLM) with students nested within classrooms was used for both main impact analyses.

Table 3

Overall Impact of IL Illustrative Math on Spring 2023 GCAS Mathematics Scores, Grades 3–5

Variable	Estimate	Standard Error	*p* value	Effect Size
IL Illustrative Math	-3.718	5.182	.473	-0.03
Constant	935.414***	3.424	<.001	
Variance of constant	898.601			
Residual	5189.791			
Student *N*	3106			
Class *N*	194			

Note. *** $p < .001$.

IL Illustrative Math students averaged slightly less than 4-point smaller gains on the GCAS assessment from BOY to EOY than did comparison students. The large *p* value and small effect size indicate that this difference in mathematics achievement gains is statistically and practically small, meaning that patterns of achievement gains were similar for students in both conditions.

Tables 4 and 5 show the results of analyses examining the impact of IL Illustrative Math on spring 2023 MAP mathematics scores. Due to differences in available prior achievement measures, separate analyses were conducted for Grade 3 students and Grades 4–5 students. Impact analyses similar to those used in the prior analysis were conducted here, with spring 2022 MAP score used as the prior achievement variable for Grades 4–5, while the BOY GCAS score was used as the prior achievement variable for the Grade 3 analysis. The analyses below examined overall composite MAP mathematics scores; MAP subscale score analyses are presented in Appendix D.

Table 4

Overall Impact of IL Illustrative Math on Spring 2023 MAP Mathematics Scores, Grades 4–5

Variable	Estimate	Standard Error	*p* value	Effect Size
IL Illustrative Math	10.907**	3.869	.005	0.28
Constant	396.78***	1.960	<.001	
Variance of constant	77.045			
Residual	645.525			
Student *N*	1,994			
Class *N*	128			

Note. ** $p < .01$; *** $p < .001$.

Table 5

Overall Impact of IL Illustrative Math on Spring 2023 MAP Mathematics Scores, Grade 3

Variable	Estimate	Standard Error	*p* value	Effect Size
IL Illustrative Math	24.358	14.601	.095	0.57
Constant	341.407***	7.337	<.001	
Variance of constant	62.086			
Residual	803.712			
Student *N*	1,022			
Class *N*	69			

Note. *** $p < .001$.

Significant positive impacts of IL Illustrative Math were evidenced for Grades 4–5 students, with treatment students in these grades outgaining comparison students by nearly 11 points. A positive program impact was also evidenced in Grade 3, with treatment students outgaining comparison students by 24 points, but this impact did not quite reach statistical significance ($p < .10$). Evidence of practical program impacts on MAP achievement gains were evidenced across all elementary students, with effect sizes of 0.28 SDs for Grades 4–5 students and 0.57 SDs for Grade 3 students. In addition, MAP subscale score analyses found significant positive program impacts of IL Illustrative Math on the Geometry ($p < .01$), Number Sense (Fractions), and Relationships/Algebraic Thinking ($p < .05$ on each) subscales, with advantages of 13–16 points for treatment students on each of these subscales. In all, impacts of IL Illustrative Math in elementary schools were much more positive on MAP mathematics scores than on GCAS mathematics scores.

Subgroup analyses. Subgroup analyses were conducted to examine the impact of IL Illustrative Math on elementary school subgroups of interest, including grade levels, special education students, ELLs, FARMS students, and ethnicity. These analyses consist of the model from the main impact analysis, along with product terms estimating the interaction between the treatment variable and subgroup dummy variable indicators. The additive effect of the treatment and treatment-by-subgroup terms were tested to allow for the examination of the unique impact of IL Illustrative Math within each subgroup of interest, as shown in Tables 6 and 7. Full tables of subgroup analysis regression tables can be found in Appendix E. Note that MAP subgroup analyses are only reported for Grades 4–5 students[3].

[3] Grade 3 was excluded from reporting due to small subgroup sample sizes. No significant subgroup impacts in Grade 3 were found.

Table 6

IL Illustrative Math Impact on Elementary GCAS Achievement, by Subgroup

Subgroup	Estimate	*p* value	*N*
Grade 3	5.163	.547	1023
Grade 4	-11.313	.214	1037
Grade 5	-6.133	.500	1046
Black	-0.357	.975	205
Hispanic	12.395	.303	194
SPED	9.067	.254	502
ELL	-8.368	.496	174
FARMS	4.116	.588	599

Table 7

IL Illustrative Math Impact on Elementary MAP Achievement, by Subgroup (Grades 4–5)

Subgroup	Estimate	*p* value	*N*
Grade 4	3.129	.493	991
Grade 5	16.201**	.001	1,003
Black	5.320	.392	114
Hispanic	6.555	.315	121
SPED	13.433**	.004	307
ELL	7.714	.231	112
FARMS	9.852*	.036	358

Note. * $p < .05$; ** $p < .01$.

No significant subgroup impacts were evidenced when examining GCAS mathematics score gains. However, significant IL Illustrative Math program impacts on MAP achievement gains were evidenced for Grade 5 students, special education students, and FARMS students. The magnitudes of these advantages ranged from 10–16 points.

Impact on Middle School Mathematics Achievement

In this section, we discuss the results of the main impact analyses examining the effect of IL Illustrative Math on middle school mathematics achievement, as measured by the GCAS and MAP assessments. We will also examine the results of subgroup analyses on both outcome measures.

Impact analyses. Tables 8 and 9 show the results of the analyses examining the impact of IL Illustrative Math on MOY GCAS and spring 2023 MAP mathematics scores.

Table 8

Overall Impact of IL Illustrative Math on Winter 2023 GCAS Mathematics Scores, Grades 7–8

Variable	Estimate	Standard Error	*p* value	Effect Size
IL Illustrative Math	15.972*	7.301	.029	0.16
Constant	1225.460***	6.686	<.001	
Variance of constant	465.553			
Residual	4596.061			
Student *N*	1875			
Class *N*	36			

Note. * $p < .05$; *** $p < .001$.

The impact of IL Illustrative Math on middle school GCAS mathematics achievement gains was statistically significant ($p = .029$), with IL Illustrative Math students averaging nearly 16-point larger gains from BOY to MOY than did comparison students. The effect size of this impact was 0.16 SDs, indicating a small-to-medium practical effect of IL Illustrative Math on mathematics achievement.

Table 9

Overall Impact of IL Illustrative Math on Spring 2023 MAP Mathematics Scores, Grades 7–8

Variable	Estimate	Standard Error	*p* value	Effect Size
IL Illustrative Math	-1.068	2.947	.717	-0.02
Constant	450.238***	2.532	<.001	
Variance of constant	37.696			
Residual	667.928			
Student *N*	1,841			
Class *N*	36			

Note. *** $p < .001$.

No significant impact of IL Illustrative Math on middle school MAP mathematics achievement gains was evidenced. Comparison students slightly outgained treatment students by approximately 1 point, with an effect size close to zero (.02 SDs). MAP achievement gains therefore were comparable for IL Illustrative Math and comparison students. While no significant program impacts were evidenced on overall MAP mathematics scores, a significant positive impact was found on the Geometry subscale, with IL Illustrative Math students outscoring comparison students by nearly 7 points (*p*

< .01). As with the elementary analyses, full results of analyses examining program impacts on MAP mathematics subscale scores can be found in Appendix D.

Subgroup analyses. The same subgroups examined in the elementary analyses were included in these analyses. Tables 10 and 11 show the impacts of IL Illustrative Math across all student subgroups for the GCAS and MAP mathematics assessments, respectively. Full tables of subgroup regression analyses can be found in Appendix F.

Table 10

IL Illustrative Math Impact on Middle School GCAS Achievement, by Subgroup

Subgroup	Estimate	*p* value	*N*
Grade 7	17.338	.100	1086
Grade 8	14.566	.130	789
Black	2.965	.822	153
Hispanic	14.056	.387	130
SPED	26.258**	.005	266
ELL	23.834	.296	106
FARMS	8.981	.371	358

Note. ** $p < .01$.

Table 11

IL Illustrative Math Impact on Middle School MAP Achievement, by Subgroup

Subgroup	Estimate	*p* value	*N*
Grade 7	-0.430	.917	1,066
Grade 8	-1.566	.667	775
Black	-4.616	.384	138
Hispanic	-3.809	.546	132
SPED	-1.723	.643	248
ELL	4.231	.634	102
FARMS	-3.967	.325	336

One statistically significant subgroup impact on the GCAS mathematics assessment was observed for special education students. Special education students who used IL Illustrative Math outgained special education comparison students by more than 26 points ($p = .005$). IL Illustrative Math impacts were directionally positive across all other subgroups on the GCAS mathematics assessment, although impacts did not reach statistical significance. No significant program subgroup analyses were evidenced on the MAP mathematics achievement.

Teacher Questionnaire Results

Major takeaways from teacher questionnaire responses are presented in the section below. We begin with findings pertaining to teacher backgrounds and IL Illustrative Math curriculum implementation. These sections are followed by results on perceived impact on student learning, professional development, and overall perceptions of the curriculum.

Background

Table 12 shows the number of questionnaire participants by school. Respondents (n = 227) represented 16 different elementary schools and four middle schools within the district.

Table 12

Respondent Numbers by School

School Name	Number of Respondents	Percentage of Respondents
Dubray Middle School	5	2.20%
North Middle School	8	3.52%
South Middle School	9	3.96%
West Middle School	13	5.73%
Dardenne Elementary School	13	5.73%
Emge Elementary School	5	2.20%
Flint Hill Elementary School	11	4.85%
Forest Park Elementary School	15	6.61%
Hawthorn Elementary School	21	9.25%
JL Mudd Elementary	8	3.52%
Lewis & Clark Elementary School	8	3.52%
Mid Rivers Elementary School	5	2.20%
Mount Hope Elementary School	5	2.20%
Ostmann Elementary School	4	1.76%
Pheasant Point Elementary School	2	0.88%
Progress South Elementary School	34	14.98%
Rock Creek Elementary School	6	2.64%
St. Peters Elementary School	11	4.85%
Twin Chimneys Elementary School	16	7.05%
Westhoff Elementary School	28	12.33%
Total	227	100%

Table 13 shows all grade(s) taught by participants. The majority of respondents (87.3%) were from elementary schools.

Table 13

Respondent Numbers by Grade Level

Grade Level	Number of Respondents/Grade	Percentage of Respondents
Kindergarten	31	11.61%
First Grade	37	13.86%
Second Grade	32	11.99%
Third Grade	49	18.35%
Fourth Grade	38	14.23%
Fifth Grade	46	17.23%
Sixth Grade	13	4.87%
Seventh Grade	14	5.24%
Eighth Grade	7	2.62%
Total	267	100%

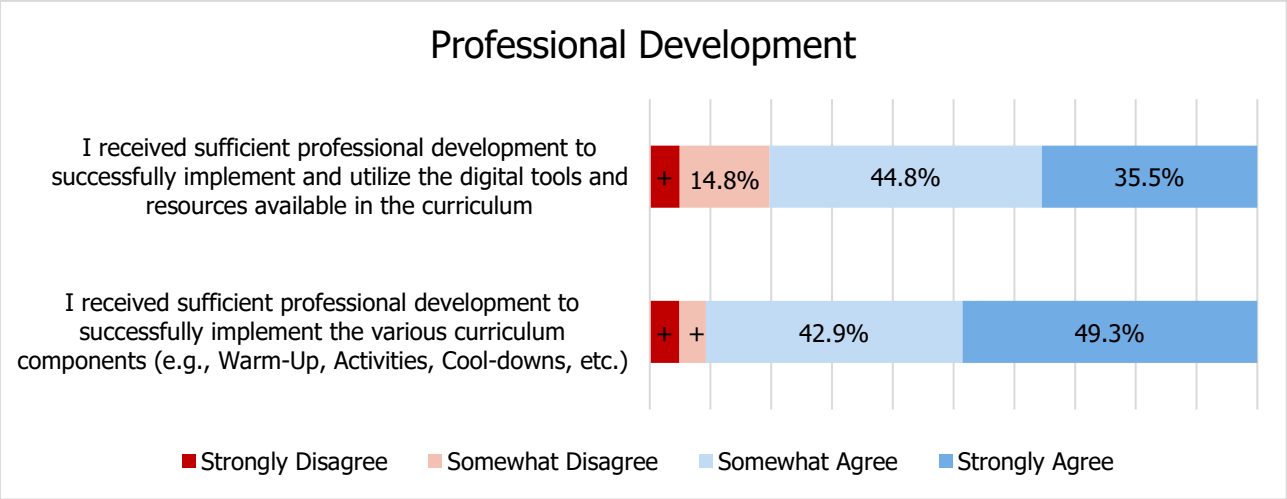
The majority of participants (85.9%) identified primarily as classroom teachers (*n* = 175) or special education (SPED) teachers (*n* = 20). Other participants included 17 coaches (7.5%) and two interventionists (0.8%). Additionally, seven school principals and six self-described "administrators" also participated in the questionnaire. The administrators and principals provided limited responses and their data was excluded from the remainder of this analysis since their role in curriculum implementation is unknown.

Professional Development

Teachers received professional development related to the IL Illustrative Math curriculum, as well as ongoing support in their implementation, at both the district and school levels. Related questionnaire items aimed to evaluate the helpfulness of this training and support. In particular, teachers were asked to indicate their level of agreement with the following statements (see Figure 1). In this set of items (and all remaining Likert-scale items), percent agreement is defined as the percentage of teachers that somewhat agree or strongly agree with an item, while percent disagreement is defined as the percentage of teachers who somewhat disagree or strongly disagree with an item.

Figure 1

Teacher Perceptions of IL Illustrative Math Professional Development



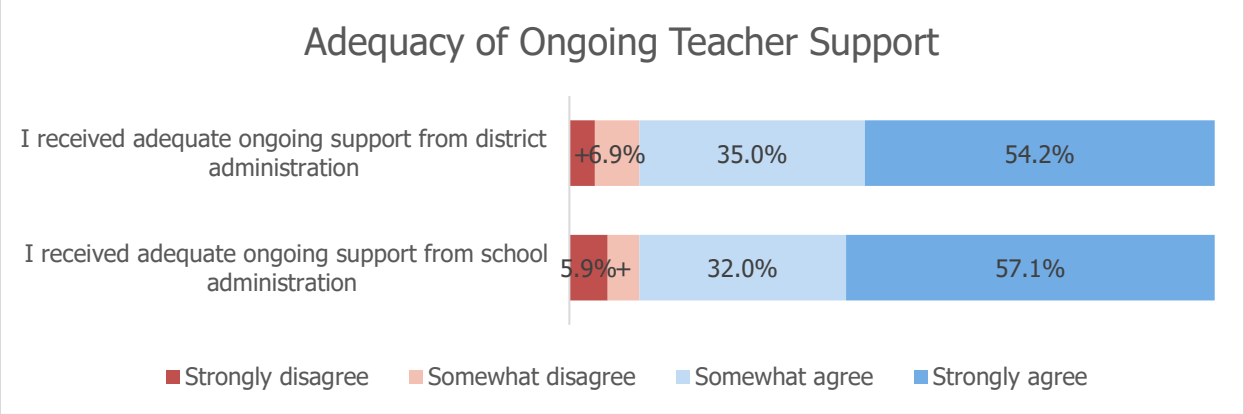
Note. + < 5%.

Teachers generally agreed that they had received sufficient training to implement both the curriculum's digital tools and resources, as well as the curricular components such as Warm-Ups and Cool Downs. However, slightly fewer teachers agreed that they had received sufficient training for the digital piece than for the curricular components.

Teachers were asked to indicate their level of agreement with statements regarding the adequacy of ongoing support that they received from their district and from their school's administration. Figure 2 depicts responses to these two items.

Figure 2

Teacher Ratings of District & School Administration Support



Note: + <5%.

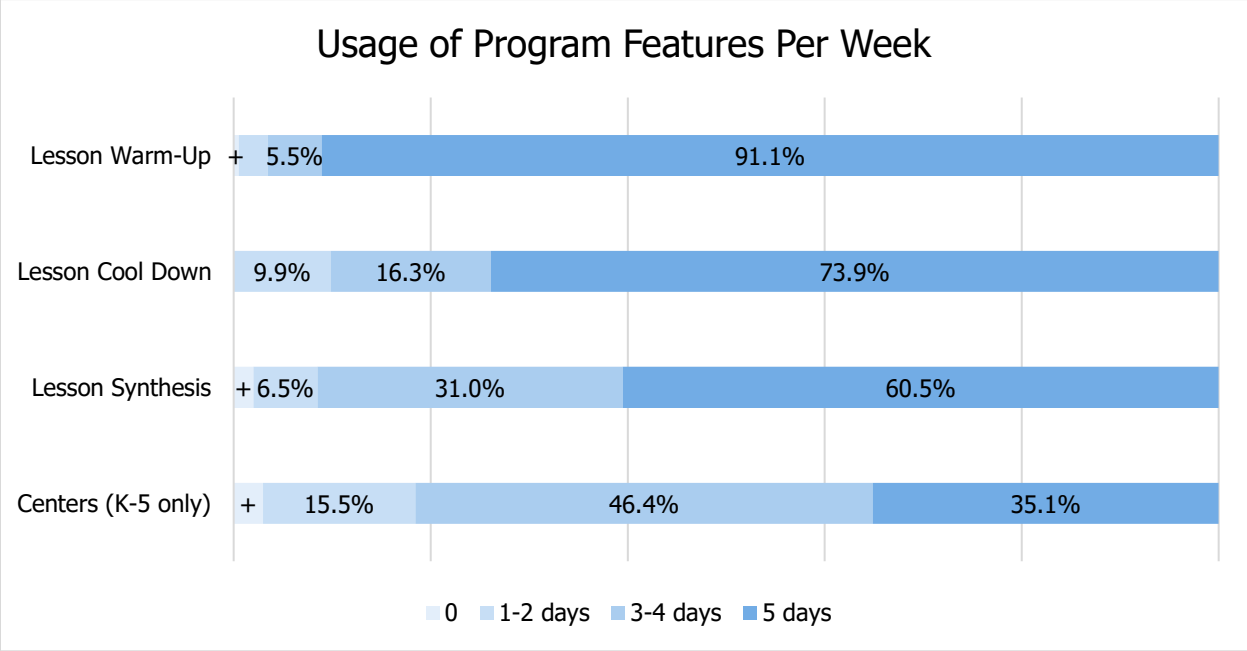
There was strong agreement among teachers that they received adequate ongoing support, with nearly 90% of teachers reporting that they received ongoing support from both district and school sources, respectively.

Curriculum Implementation

Regarding the implementation of IL Illustrative Math, roughly one-third of teachers (38.6%) reported that they had used the curriculum prior to the 2022–23 school year, whereas roughly two-thirds of participants (61.4%) indicated that they had not. Teachers were then asked to specify their usage frequency for specific curriculum features when teaching math, either on paper or on the digital platform. Figure 3 displays these results.

Figure 3

Frequency of Usage for IL Illustrative Math Program Features



Note. + < 5%.

Of the four features, teachers reported the highest frequency usage for the Lesson Warm-Up and Lesson Cool Down features (91.1% and 73.9%, respectively, used daily). Lesson Synthesis was also utilized by a majority of teachers (60.5%) each day whereas Centers (a feature only in Grades K–5) saw the lowest daily usage (35.1%).

As part of the questionnaire, teachers were asked four open-ended questions in order to provide more extensive feedback, in their own words, on several topics regarding program implementation and satisfaction. The first of these queries was

related to the use of program features, asking teachers if they had deviated from the typical "flow" in the presentation of lessons and if so, how? Roughly one-third (*n* = 45, 29.6%) of the 152 teachers who responded indicated that they had not deviated from the typical flow. Teacher comments included: "I did not deviate from this structure. It effectively supported student learning," and, "We did this flow and found that sometimes cool downs made student[s] not want to start a lesson and cool downs didn't always go with the lessons." This second comment indicates that some of the teachers who followed the typical flow did not find that it always worked optimally for them. The remaining 107 participants (70.4%) who indicated that they had deviated from the typical flow described the deviations they had made, and 70 participants (46.1%) provided reasons for why they had done so. The majority of deviations took one of the following two forms:

- The teacher did less of/shortened the typical flow (*n* = 50, 32.9%)
- The teacher re-ordered the typical flow (*n* = 46, 30.3%)

Teachers who described having done less than the prescribed lesson material in the lessons, or having shortened the lesson, typically attributed the deviation to a lack of time (*n* = 43, 86.0%). Teachers' remarks on this included:

> *Centers was the only issue I have had this year. My struggle has been trying to fit it all in and given this was our pilot year I often felt overwhelmed doing all of the other things. However, next year I do not foresee it being an issue.*
>
> *Timing is the biggest challenge, especially in kindergarten. Some activities took longer than what the book said. The reality of teaching kindergarten is things take longer and we need to account for transitioning, behaviors, directions, getting materials passed out, etc.*
>
> *My math instructional time does not allow for the full lesson to be taught in one chunk so we do our lesson for 10 minutes in the morning, followed by centers, and then a few hours later we do the first two activities, break for 20 min., recess and then do the synthesis and cool down.*

The regular incorporation of Centers (a component of the Grades K–5 curriculum) into the daily schedule was specifically noted as being particularly challenging by some teachers (*n* =15, 9.9%). However, confronting a shortage of time was not always perceived to be a negative, as shown in the following teacher's comment, "The deviation was not intentional as I had a difficult time moving on when students were engaged in rich mathematical conversation which lead to me not getting to centers every day." Small numbers of teachers indicated that they had shortened lessons or done "less" because of a variety of reasons including the need for more student practice, because the lessons were "too hard"/students grew frustrated, or

because the teachers felt the omitted material wasn't needed/was redundant. Over two-thirds (69.57%) of the teachers who reported having re-ordered the lesson flow said this was because they moved Centers to being the first activity of the day. A small number of teachers (*n* = 4, 8.7%) indicated this had been a school-wide or district-level decision, as described in this teacher's comment:

> *We decided with input from district math coordinators, to move center time to be before starting lesson warm up. It worked as a "warm up" before the warm up. It got students into partnerships and into math thinking before the lesson begins.*

Other teachers indicated that they preferred to do Centers first out of preference as seen in these examples, "I follow the lesson flow as it is supposed to be done. Some days I would start with centers as this worked better for some of the lessons," and "Sometimes we will do Centers at the beginning to get students into the math mindset." The most common additional reason given for the reordering of lessons was lack of time (*n* = 9, 5.11%), with smaller numbers of teachers saying that it was a result of their having combined activities or because they, as implementers, still needed to improve their use of the curriculum.

A small number of teachers (*n* = 14, 9.2%) who provided answers other than those outlined above stated they had deviated from the typical lesson flow for a variety of reasons. Most commonly, teachers (*n* = 8, 5.2%) repeated units or added additional practice opportunities for their students. Observations from these teachers included, "I did more visuals such as filling out graphic organizers to help my visual learners," and "There were various units where the students needed more practice/repetition to access skills from the previous year." One special education teacher also commented, "Often the activities were too hard. I teach in the Gen Ed but also in the SPED setting and the activities were too hard for many of the students to do. They need more repetition and explanation." Overall, teachers appear to have followed the planned lesson flow for the program with small numbers indicating that they continued to struggle with trying to "fit" the entire lesson plan into classroom time allocated to math.

Teachers were nearly unanimous (96.5%) in agreeing that implementation of the curriculum got easier as the year progressed. This opinion was further supported in open-ended responses where one teacher summed up the comments this way,

> *I feel like I will be better prepared overall, just because I now know what comes throughout the entire year. I will also prepare for the specific areas that were challenging to this year's group, and present it in a more guided way.*

In an open-ended query, teachers were asked what they planned to do differently when implementing IL Illustrative Math in the 2023–24 school year. Out of 190 teacher responses, six teachers (3.2%) indicated they would make no changes, five

(2.6%) answered "N/A," and three (1.6%) indicated they did not know. The most common response given from over 40% of the remaining respondents (*n* = 78, 41.1%) was the intention to be better prepared/more organized in their implementation in the next school year. Roughly half of these teachers (*n* = 40, 21.1%) specified that they wanted to improve their organization when it came to teaching Centers and maintaining Center materials. Teachers said they planned to prep their Centers early/over the summer and others spoke of improving the way they prepped and stored items like activity cards and games. The other main differences that teachers planned to make were as follows:

- Change in the timing/length of time of Centers (*n* = 42, 22.1%). Roughly half of these teachers (*n* = 23, 12.1%) planned to use Centers more frequently while roughly one-third (*n* = 12, 6.3%) intended to move Centers to the start of the daily math lesson.
- Improve time management/pacing during lessons (*n* = 30, 15.8%). Teachers intended to be more cognizant of the time being spent on curricular activities in order to "fit" everything in. Some (*n* = 10, 5.3%) proposed using timers to assist this effort.

Related teacher comments included:

> *I feel more confident with the curriculum, so trying to experiment more with the centers with student pairings, intervention groups, etc. is a goal of mine. There have been things I've learned through this year about teaching the center activities (inviting students to play against the teacher, or in a central place in the room), structured classroom pairings (A/B partnerships), and careful consideration of assessments. I would like to try to plan misconceptions or missing links in prior learnings for students who have not experienced ILIM.*

> *[IL Illustrative Math] prep is way more work than [the] previous curriculum. Prepping for centers and activities is very time consuming. It would have been nice if the material was provided to you like our previous curriculum. Other than the prep I have enjoyed ILIM. My students really enjoyed it.*

> *Next year, I expect to benefit from the students coming in having a year of IM experience, which will allow me to implement better routines and math practices from the very start of the year. I will have better pacing and management when it comes to prioritizing certain activities and ensuring that warm ups and the synthesis happens each day in a meaningful way.*

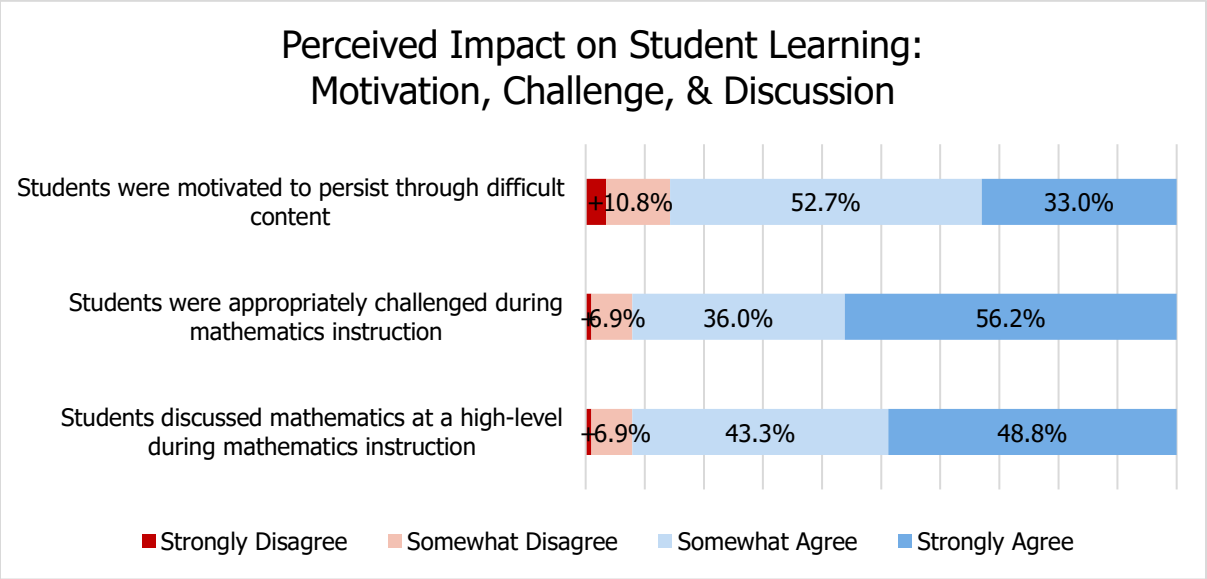
Finally, smaller numbers of teachers (less than five) indicated that they would make changes to other aspects of their implementation, such as increasing use of the digital component of the curriculum, using the curriculum with greater consistency, and providing occasional direct instruction.

Perceived Impact on Student Learning

Teachers reported on their perceived impact of IL Illustrative Math on student learners in terms of engagement and student achievement. Figure 4 displays these findings.

Figure 4

Perceived Impact on Student Engagement



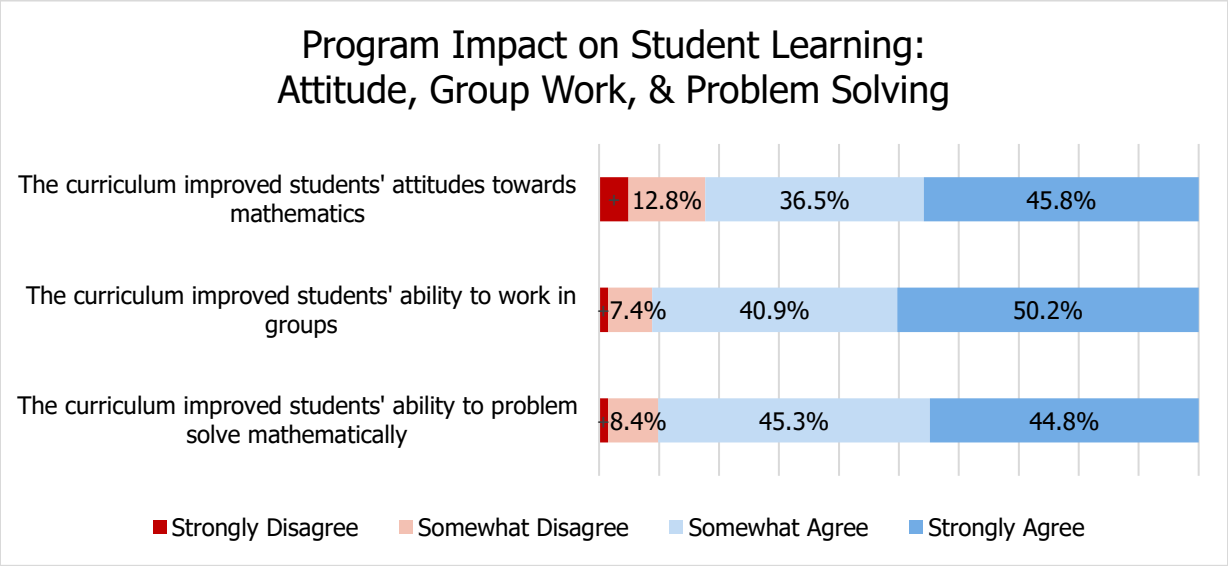
Note. + < 5%.

Largely, teachers agreed the curriculum motivated students to persist through difficult content (85.7%), challenged students appropriately (92.2%), and led students to engage in high-level discussions during math instruction (92.1%).

Teachers were presented with a set of three items relating to Imagine Learning Illustrative Mathematics' impact on student learning. Figure 5 details these findings.

Figure 5

Perceived Impact of IL Illustrative Math on Student Mathematics Learning



Note. + < 5%.

There was strong agreement among teachers that the curriculum positively impacted student attitudes towards math, their ability to work in groups, and their ability to problem solve mathematically, with roughly half of all teachers strongly agreeing with these statements. Tied to these findings were responses to a second open-ended query which asked teachers to describe how the IL Illustrative Math curriculum differed from other math curricula to a teacher who was new to IL Illustrative Math or to teaching math. The most commonly cited differences referenced by 183 respondents were as follows:

- It is a student-led, hands-on/problem-based curriculum (*n* = 54, 28.7%)
- The curriculum provides students with a deeper understanding of math (*n* = 43, 22.9%)
- The curriculum incorporates extensive group and partner work (*n* = 40, 21.3%)

Nearly 30% of teachers spoke of IL Illustrative Math's hands-on format for student learning. One teacher related, "This curriculum allows for students to discover their own learning with the teacher there as a guide. It is extremely engaging for students and the activities are very kid-friendly," and another added, "Much, much more hands on for the kids and a lot more fun." Speaking on the implementation from a teacher's point of view a teacher noted that, "Moving to a new way of teach[*sic*] is always challenging and the problem-based approach is unfamiliar to many. However,

we were able to see great student success with this program." Another teacher spoke to the challenge of implementing a new curriculum saying:

> *My workflow as a teacher is very different using IM curriculum resources. Instead of spending lots of hours creating or curating lesson activities, practice problems, and assessments these resources are already ready to use. But since I didn't need to do that work, I had to take more time working through the materials "like a student" to better understand the progressions of concepts and the intention behind some activities (things that I could just skim over in the past when I had done that work on the front end by creating or finding/adjusting over resources).*

Teachers who commented on the curriculum's ability to deepen a student's understanding of math provided feedback with one saying, "This math curriculum creates mathematical thinkers inside of your classroom. It will get students talking and really thinking about their math, rather than just producers," and another adding:

> *This curriculum is different in a way that it "forces" students to think about mathematical situations in a deeper level of thinking … I also think this curriculum ties many of the mathematical problems to real work situations which is HUGE for students.*

Teachers who noted the curriculum's high level of collaborative partner and group work viewed this as a curriculum strength. Teachers described a positive impact on student learning gained through students having opportunities to practice math language and problem-solving with others and being able to share their ideas/thinking. One teacher spoke to this point saying:

> *The dynamics that come from the problem solving, inquiry model and discussion supports has opened math thinking up for all learners. Students are gaining entry points to the learning, questioning peers for clarity or understanding, and showing me things I never would have thought about before. Trust in the depth and the challenge...the students will rise to it!*

Smaller numbers of teachers identified several additional differences of IL Illustrative Math to other math curricula:

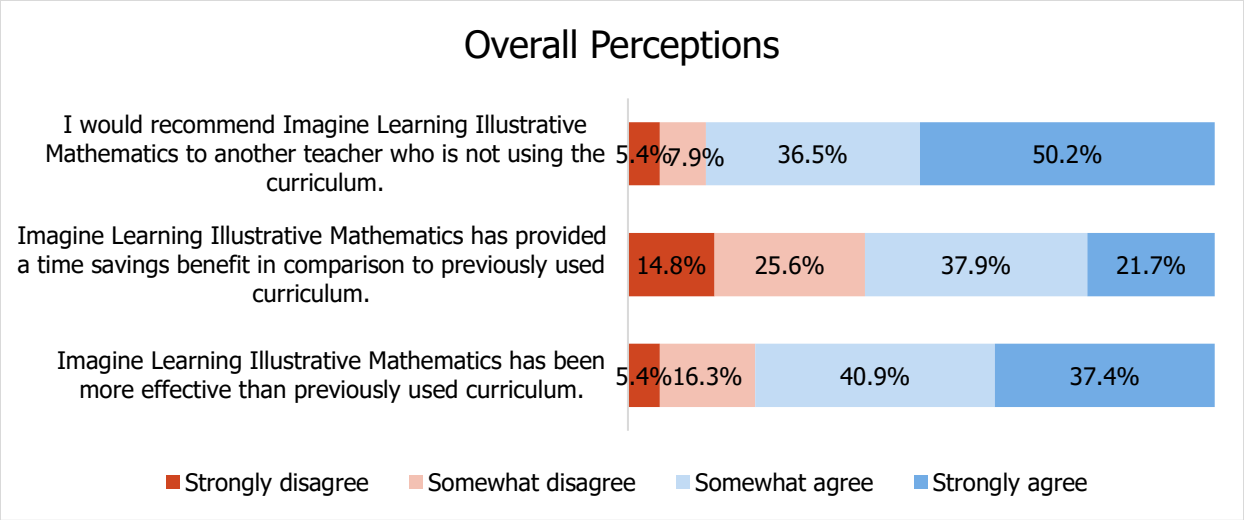
- IL Illustrative Math is engaging to students (*n* = 23, 12.2%)
- Implementation requires additional prep time/organization (*n* = 21, 11.2%)
- The curriculum is inclusive of all ability levels/allows for differentiation (*n* = 21, 11.2%)
- Teachers find it user-friendly/easy to follow (*n* = 18, 9.6%)

Overall Perceptions

Teachers were asked to provide their overall perceptions of the curriculum in terms of whether respondents would recommend the program to others, if it had provided a time-saving benefit versus previously used curricula, and whether it had been more effective than a previously used curriculum (see Figure 6).

Figure 6

Overall Perceptions Regarding IL Illustrative Math



Over 85% of participants agreed that they would recommend the curriculum to another teacher who is not using the curriculum. Over half (59.6%) of the participants indicated that IL Illustrative Math had provided a time savings benefit. However, over three-quarters of teachers (78.3%) agreed that the program had been more effective than the previously used curriculum.

The fourth and last open-ended query asked teachers what advice they would give about implementing the curriculum effectively to another teacher who was new to IL Illustrative Math. Just as in the previous query, the most common advice offered in the 191 responses was that implementers should plan ahead/be organized (n = 85, 44.3%). Suggestions for this included doing prep work prior to the week of teaching, setting a routine for instruction, and organizing Centers. One teacher stated, "If you are prepared and know your content, your students will rise to the occasion," and another added:

> *Although it is a lot of prep, in the end, it was worth it! The knowledge and understanding that my students have about math is so much deeper than*

> *with prior curriculums. It was a mindset change on my behalf and did take some adjusting on my end. Allow students to share, explain, and have those conversations amongst peers. I would say let it get messy and trust the process!*

The advice to "be patient" and "take your time" was the next most frequently named guidance noted by teachers (*n* = 50, 26.0%). One teacher offered reassurance saying, "Stick with it! It can be overwhelming (a lot of prep) at the beginning, but once you get the hang of it and get a good system down it's definitely a great program!" and another noted, "Take things day by day! It will get easier as you become more comfortable with the curriculum." Other recommendations to new implementers included being thoughtful about time management (*n* = 20, 10.4%), making use of resources such as notes and slides (*n* = 18, 9.4%), and the recommendation that nothing from the curriculum be "skipped" or "left out" (*n* = 10, 5.2%). As one teacher noted, "Follow and trust the process. The warm-ups lead to the activities. The activities lead to the cool-down. They all work together." Finally, smaller numbers of teachers advised new implementers to remain flexible, to let their students talk through problems together, and to work with their teaching team for support.

Taken together, these findings underscore the teacher perceptions that IL Illustrative Math positively impacted student learning both in terms of student engagement and achievement in mathematics instruction. Teachers also strongly agreed that implementation of the curriculum became easier as the school year progressed.

Discussion

The current study was a mixed-methods study designed to provide efficacy and teacher satisfaction evidence for the IL Illustrative Math program. Impacts on student mathematics achievement were determined for Grades 3–8 students in the Fort Zumwalt School District by comparing treatment students who participated in IL Illustrative Math with those who did not. This report includes findings from student achievement, as well as teacher perceptions obtained through a questionnaire administered to teachers who used IL Illustrative Math.

Elementary school results showed that Grades 4 and 5 students who used IL Illustrative Math significantly outgained comparison students on the Spring 2023 MAP mathematics assessment. IL Illustrative Math students averaged nearly 11-point larger gains from spring 2022 to spring 2023. No significant impact was found for Grade 3 students, but effect sizes of 0.28 SDs for Grades 4 and 5 students and 0.57 SDs for Grade 3 students, indicated medium to large practical program impacts. No significant impacts of IL Illustrative Math on GCAS mathematics scores were observed for elementary students. Subgroup analyses showed a significant positive impact of IL Illustrative Math on MAP mathematics scores for special education students, with

treatment special education students outscoring comparison special education students by more than 13 points.

Results for middle school (Grades 7 and 8) showed that students who used IL Illustrative Math significantly outgained comparison students on the Winter 2023 GCAS mathematics assessments. In relation to comparison students, IL Illustrative Math students averaged nearly 16-point larger gains from BOY to MOY in the 2022-23 school year. The effect size of 0.16 SDs shows both practical and statistical significance of these impacts. No statistically significant program impacts on MAP mathematics scores were found in these analyses; however, a significant positive program impact on Geometry MAP subscale scores was observed. In addition, a significant positive impact of IL Illustrative Math on GCAS mathematics scores was observed for special education students, with treatment special education students outscoring comparison special education students by more than 26 points. Taken together, these analyses provide efficacy evidence that may reach ESSA Tier 2 ("Moderate") levels for elementary school grades.

Teacher perceptions of IL Illustrative Math were generally positive with most teachers (87%) agreeing that they would recommend the curriculum to others. Teachers provided particularly positive feedback regarding the curriculum appropriately challenging students during math instruction, improving students' ability to work in groups, and enabling high-level student discussion of mathematics during instruction. In describing how IL Illustrative Math differed from other math curricula, teachers highlighted that it was student-led, provided students with a deeper understanding of math, and that it incorporated extensive group/partner work into math instruction. Additionally, there was strong agreement amongst teachers that the curriculum helped students persist through difficult content and improved their ability to problem solve mathematically, and over 80% of teachers agreed that the curriculum improved students' attitudes towards mathematics.

Learning to implement the curriculum within the time limits of the mathematics block appeared to be challenging for teachers, especially early in the school year. Many teachers (70.4%) indicated that they had deviated from the typical lesson flow, either by doing less due to a lack of time, or by re-ordering the timing of Centers. In open-ended responses, teachers stated that to combat this challenge they intended to be better prepared/organized in the next school year, especially when it came to Centers.

Teachers agreed that they had received adequate support both from their district and school administrations during implementation. They also agreed that they had received sufficient professional development to successfully implement the various curricular components of IL Illustrative Math including the digital tools and resources associated with the curriculum, although agreement was somewhat lower for the digital piece. Notably, over 75% of teachers agreed that IL Illustrative Math was more effective than the previously used curriculum, while being slightly less likely to perceive

it as providing a time savings benefit (40% disagreed that it saved time). Finally, nearly all teachers (97%) agreed that implementation got easier as the school year progressed. In response to an open-ended query, roughly 45% of respondents stated that they would advise new implementers of the curriculum to plan ahead and be organized in order to be successful.

Conclusions

In considering overall conclusions from this study, it is important to consider that IL Illustrative Math is a relatively new program that asks teachers to make considerable changes to their classroom processes and structures and this study captures a first-year implementation of IL Illustrative Math in FZSD. Questionnaire data indicates that teachers, who generally perceived the program very positively, took considerable time becoming comfortable with program implementation. Another necessary consideration is the nature of how the GCAS assessment was administered in middle grades. While the FZSD BOY and MOY GCAS assessments function as typical progress monitoring assessments, EOY GCAS assessments are more summative in nature and, thus, function somewhat differently than BOY and MOY assessments, and scores also should be interpreted differently. These intra-year assessment differences may help to explain the different patterns of results between elementary students, who only took the GCAS at BOY and EOY, and middle school students, who took the GCAS at all three timepoints. The significant positive findings for elementary IL Illustrative Math students on the MAP mathematics assessment provide additional evidence of the efficacy of IL Illustrative Math in the elementary grades. It is important to note that the GCAS assessments are originally designed as a benchmarking assessment to be administered at three time points throughout the year. As such, this adjustment in FZSD justifies the analysis in middle grades focusing on BOY to MOY results as this truly captures students' progress since the middle grades EOY assessment was more summative in nature.

In all, the results of this evaluation showed generally positive findings regarding both student achievement impacts and teacher program perceptions relating to IL Illustrative Math. At the elementary and middle school levels, statistically significant overall program effects (and associated moderately strong effect sizes) on MAP and GCAS, respectively, appear to provide "moderate" evidence support (Tier 2) for both ESSA and the What Works Clearinghouse (meets standards with reservations). One limitation of this evaluation was that program usage data were not available, as IL Illustrative Math contains both digital and print components, thus prohibiting the ability to accurately calculate the total time that students engaged with the curriculum and program components. Program usage data may help to examine potential associations between program dosage and achievement gains, and other similar finer-grained analyses of observed achievement gains. Further evaluation is encouraged in subsequent years to further examine potential program impacts of IL Illustrative Math on mathematics achievement, especially as teachers gain greater experience and comfort with the program.

Appendix A: Teacher Questionnaire

Please indicate your school.

- Dubray Middle School
- North Middle School
- South Middle School
- West Middle School
- Dardenne Elementary School
- Emge Elementary School
- Flint Hill Elementary School
- Forest Park Elementary School
- Hawthorn Elementary School
- JL Mudd Elementary
- Lewis & Clark Elementary School
- Mid Rivers Elementary School
- Mount Hope Elementary School
- Ostmann Elementary School
- Pheasant Point Elementary School
- Progress South Elementary School
- Rock Creek Elementary School
- St. Peters Elementary School
- Twin Chimneys Elementary School
- Westhoff Elementary School

What is your primary role?

- Classroom teacher
- Interventionist
- Instructional Aid/Paraprofessional
- Coach
- Other, please specify: _____

What grade(s) do you teach? (Check all that apply.)

- Kindergarten
- First Grade
- Second Grade
- Third Grade
- Fourth Grade
- Fifth Grade
- Sixth Grade
- Seventh Grade
- Eighth Grade
- None of the above

Have you used ILIM prior to the 2022-2023 school year?

- Yes
- No

When teaching math using ILIM, how often do you do the following (either on paper or on the digital platform)?

	0 times per week	1-2 times per week	3-4 times per week	5 days per week	N/A
Lesson Warm-Up					
Lesson Cool Down					
Lesson Synthesis					
Centers (K-5 only)					

Please rate the extent to which you agree or disagree with each of the following statements.

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
Students were motivated to persist through difficult content.				
Students were appropriately challenged during mathematics instruction.				
Students discussed mathematics at a high-level during mathematics instruction.				
The curriculum improved students' attitudes towards mathematics.				
The curriculum improved students' ability to work in groups.				
The curriculum improved students' ability to problem solve mathematically.				
Implementing the curriculum got easier as the year progressed.				

I received sufficient professional development to successfully implement and utilize the digital tools and resources available in the curriculum.
I received sufficient professional development to successfully implement the various curriculum components (e.g., Warm-Up, Activities, Cool-downs, etc.)
I received adequate ongoing support from district administration.
I received adequate ongoing support from school administration (e.g., principals, coaches).
I would recommend ILIM to another teacher who is not using the curriculum.

ILIM has provided a time savings benefit in comparison to previously used curriculum.	
ILIM has been more effective than previously used curriculum.	

A typical ILIM lesson starts with a warm up, includes at least one activity, and ends with a synthesis, cool down, and, if you are in Grades K–5, centers. If you deviated from this typical flow for a lesson, describe what you did differently and why.

What would you say about how this curriculum is different from other math curricula to another teacher who was new to ILIM? Someone who is new to teaching math?

As you look toward next year, what will you do differently when you utilize ILIM in your classroom?

What advice would you give about implementing the curriculum effectively to another teacher who was new to ILIM?

Appendix B: Baseline Equivalence Tables

Table B1

Baseline Equivalence, 2023 BOY GCAS Scores, Grades 3-5

	Overall Mean	Imagine Mean (SD)	Control Mean (SD)	Adjusted T v C Difference	Pooled Unadjusted SD	Stan. Mean Diff.
Grade 3	721.27	720.65 (73.36)	721.87 (70.50)	-1.21	71.92	-0.02
Grade 4	808.51	809.12 (68.39)	808.17 (69.61	0.95	69.18	0.01
Grade 5	898.52	892.22 (77.74)	904.61 (79.37)	-12.39	78.57	-0.16
All Students	810.09	807.76 (104.21)	811.95 (102.11)	-4.19	103.05	-0.04

Table B2

Baseline Equivalence, 2023 BOY GCAS Scores, Grades 7-8

	Overall Mean	Imagine Mean (SD)	Control Mean (SD)	Adjusted T v C Difference	Pooled Unadjusted SD	Stan. Mean Diff.
Grade 7	1160.88	1164.04 (77.17)	1145.01 (76.05)	19.024	76.99	0.25
Grade 8	1219.09	1216.64 (48.68)	1223.98 (45.60)	-7.34	47.68	-0.15
All Students	1185.36	1183.36 (72.66)	1191.89 (71.29)	-8.54	72.34	-0.12

Appendix C: Descriptive Achievement Tables

Table C1

Elementary GCAS Mathematics Scores

	BOY	MOY	*N*	Growth
Grade 3				
IL Illustrative Math	720.65 (73.36)	820.45 (98.62)	504	99.80
Comparison	721.87 (70.50)	820.70 (99.46)	519	98.83
Grade 4				
IL Illustrative Math	809.12 (68.39)	944.02 (97.46)	364	134.90
Comparison	808.17 (69.61)	956.27 (105.13)	673	148.10
Grade 5				
IL Illustrative Math	892.22 (77.74)	1021.41 (99.17)	514	129.19
Comparison	904.61 (79.37)	1036.75 (98.62)	532	132.14

Note. SD in parentheses.

Table C2

Middle School GCAS Mathematics Scores

	BOY	MOY	*N*	Growth
Grade 6				
IL Illustrative Math	1069.67 (75.44)	1153.75 (80.71)	1,068	86.08
Comparison	972.36 (66.54)	1007.64 (81.47)	47	35.28
Grade 7				
IL Illustrative Math	1164.04 (77.17)	1208.46 (85.60)	906	44.42
Comparison	1145.01 (76.05)	1173.16 (85.27)	180	28.15
Grade 8				
IL Illustrative Math	1216.64 (48.68)	1291.31 (92.22)	526	74.67
Comparison	1223.98 (45.60)	1293.45 (87.45)	263	69.47

Note. SD in parentheses.

Table C3

Elementary MAP Mathematics Scores

	BOY	MOY	*N*	Growth
Grade 4				
IL Illustrative Math	367.53 (37.58)	396.29 (41.98)	347	28.76
Comparison	357.48 (39.58)	396.44 (39.90)	644	38.96
Grade 5				
IL Illustrative Math	388.57 (38.00)	409.71 (35.92)	494	31.14

Comparison	397.93 (38.32)	408.09 (34.75)	509	20.16

Note. SD in parentheses.

Table C4

Middle School MAP Mathematics Scores

	BOY	MOY	*N*	Growth
Grade 6				
IL Illustrative Math	413.28 (30.44)	425.46 (30.33)	1,037	12.18
Comparison	334.98 (33.63)	361.98 (35.33)	47	27.00
Grade 7				
IL Illustrative Math	423.68 (30.26)	441.71 (38.40)	892	18.03
Comparison	409.32 (39.44)	433.76 (44.29)	174	24.44
Grade 8				
IL Illustrative Math	428.23 (33.93)	461.61 (46.72)	521	33.38
Comparison	426.83 (32.46)	466.39 (39.60)	254	39.56

Note. SD in parentheses.

Appendix D: MAP Subscale Results

Table D1

MAP Mathematics Subscale Regression Results, Grades 4–5

Subscale	Estimate	Standard Error	*p* value
Base Ten Numbers	-0.086	6.094	.989
Fractions	13.109*	5.180	.011
Algebraic Thinking	12.557*	5.968	.035
Geometry	16.280**	5.192	.002

Note. * $p < .05$; ** $p < .01$.

Table D2

MAP Mathematics Subscale Regression Results, Grade 3

Subscale	Estimate	Standard Error	*p* value
Base Ten Numbers	36.645	30.469	.229
Fractions	43.836	27.158	.107
Algebraic Thinking	8.246	18.580	.657
Geometry	32.571	21.059	.122

Table D3

MAP Mathematics Subscale Regression Results, Grade 7–8

Subscale	Estimate	Standard Error	*p* value
Rations/Proportions	1.010	2.743	.713
Number Sense	-0.895	3.786	.813
Equations/Inequalities	-7.278*	3.351	.030
Geometry/Measurement	6.969**	2.537	.006

Note. * $p < .05$; ** $p < .01$.

Appendix E: Subgroup Regression Tables – Elementary

All regression models controlled for prior mathematics achievement, grade, FARMS, and SPED status, as well as school effects. In addition, all variables were grand mean centered to facilitate interpretation of the intercept. Student and classroom sizes were identical to those outlined in previous regression tables. Note that the treatment effect for each subgroup was calculated by adding the overall treatment effect and the treatment interaction term.

Table E1

GCAS Mathematics Regression Results with SPED Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-6.835	5.385	.204
Illustrative*SPED	15.901*	7.502	.034
SPED	-58.019***	5.424	<.001
Constant	935.651***	3.424	<.001

Note. * $p < .05$; *** $p < .01$.

Table E2

GCAS Mathematics Regression Results with FARMS Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-3.619	5.364	.500
Illustrative*FARMS	-0.497	6.948	.943
FARMS	-21.745***	4.682	<.001
Constant	935.411***	3.424	<.001

Note. *** $p < .001$.

Table E3

GCAS Mathematics Regression Results with ELL Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-3.434	5.226	.511
Illustrative*ELL	-4.934	11.841	.677
ELL	4.764	9.109	.601
Constant	935.409***	3.423	<.001

Note. *** $p < .001$.

Table E4

GCAS Mathematics Regression Results with Grade-Level Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (Grade 3)	5.163	8.582	.547
Illustrative*Grade 4	-16.477	12.508	.188
Illustrative*Grade 5	-11.297	12.494	.366
Constant	935.209***	3.410	<.001

Note. *** $p < .001$.

Table E5

GCAS Mathematics Regression Results with Ethnicity Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (non-Black/Hispanic)	-5.114	5.294	.334
Illustrative*Black	4.757	10.820	.660
Illustrative*Hispanic	17.509	11.596	.131
Constant	935.493***	3.429	<.001

Note. *** $p < .001$.

Table E6

MAP Mathematics Regression Results with SPED Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	10.297**	3.913	.009
Illustrative*SPED	3.136	3.341	.348
SPED	-31.219***	2.309	<.001
Constant	396.844***	1.957	<.001

Note. ** $p < .01$; *** $p < .001$.

Table E7

MAP Mathematics Regression Results with FARMS Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	11.154**	3.922	.004
Illustrative*FARMS	-1.302	3.261	.690
FARMS	-6.827**	2.010	.001
Constant	396.755***	1.965	<.001

Note. ** $p < .01$; *** $p < .001$.

Table E8

MAP Mathematics Regression Results with ELL Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	11.065**	3.875	.004
Illustrative*ELL	-3.351	5.409	.536
ELL	0.958	3.914	.807
Constant	396.793***	1.960	<.001

Note. ** $p < 01$; *** $p < .001$.

Table E9

MAP Mathematics Regression Results with Grade-Level Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (Grade 4)	3.129	4.564	.493
Illustrative*Grade 5	13.072**	4.482	.004
Constant	397.112***	1.884	<.001

Note. ** $p < .01$; *** $p < .001$.

Table E10

MAP Mathematics Regression Results with Ethnicity Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (non-Black/Hispanic)	11.375**	3.884	.003
Illustrative*Black	-6.054	5.095	.235
Illustrative*Hispanic	-4.820	5.485	.380
Constant	396.829***	1.962	<.001

Note. ** $p < .01$; *** $p < .001$.

Appendix F: Subgroup Regression Tables – Middle

Table F1

GCAS Mathematics Regression Results with SPED Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	5.706	8.759	.515
Illustrative*SPED	20.552	11.028	.062
SPED	-56.529***	9.232	<.001
Constant	1231.688***	7.154	<.001

Note. *** $p < .001$.

Table F2

GCAS Mathematics Regression Results with FARMS Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	18.571*	7.684	.016
Illustrative*FARMS	-9.591	9.184	.296
FARMS	-5.980	7.889	.448
Constant	1224.818***	6.734	<.001

Note. * $p < .05$; *** $p < .001$.

Table F3

GCAS Mathematics Regression Results with ELL Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	15.600*	7.342	.034
Illustrative*ELL	8.234	22.482	.714
ELL	-5.676	22.162	.798
Constant	1225.314***	6.696	<.001

Note. * $p < .05$; *** $p < .001$.

Table F4

GCAS Mathematics Regression Results with Grade-Level Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (Grade 8)	14.566	9.625	.130
Illustrative*Grade 7	2.772	13.920	.842
Constant	1225.242***	6.883	<.001

Note. *** $p < .001$.

Table F5

GCAS Mathematics Regression Results with Ethnicity Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (non-Black/Hispanic)	18.178*	7.556	.016
Illustrative*Black	-15.212	12.421	.221
Illustrative*Hispanic	-4.122	15.633	.792
Constant	1224.874***	6.713	<.001

Note. * $p < .05$; *** $p < .001$.

Table F6

MAP Mathematics Regression Results with SPED Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-0.480	3.575	.893
Illustrative*SPED	-1.243	4.282	.772
SPED	-3.014	3.700	.415
Constant	449.888***	2.804	<.001

Note. *** $p < .001$.

Table F7

MAP Mathematics Regression Results with FARMS Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-0.204	3.058	.947
Illustrative*FARMS	-3.764	3.588	.294
FARMS	-3.272	3.078	.288
Constant	450.089***	2.532	<.001

Note. *** $p < .001$.

Table F8

MAP Mathematics Regression Results with ELL Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math	-1.233	2.957	.677
Illustrative*ELL	5.465	8.647	.527
ELL	-1.085	8.460	.898

Constant	450.095***	2.541	<.001

Note. *** $p < .001$.

Table F9

MAP Mathematics Regression Results with Grade-Level Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (Grade 8)	-1.566	3.645	.667
Illustrative*Grade 7	1.136	5.023	.821
Constant	450.087***	2.622	<.001

Note. *** $p < .001$.

Table F10

MAP Mathematics Regression Results with Ethnicity Interaction

	Estimate	Standard Error	*p* value
IL Illustrative Math (non-Black/Hispanic)	-0.344	3.028	.909
Illustrative*Black	-4.272	4.981	.391
Illustrative*Hispanic	-3.464	5.973	.562
Constant	450.115***	2.533	<.001

Note. *** $p < .001$.