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Go Math! Elementary Grades Efficacy Study

Houghton Mifflin Harcourt

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Abstract

The focus of this study was the effectiveness of Go Math! © 2015 a mathematics program for elementary grade students published by Houghton Mifflin Harcourt. The study included students from 10 different schools in 4 different states. The overall demographics of the study sample are somewhat representative of the demographics of students enrolled in public schools in the United States. Compared to national averages there were about 7% fewer students eligible for free/reduced lunch programs. Again compared to the national average there were about 9% fewer non-Caucasian students in the research sample.

The study was conducted with over 2,200 students enrolled in grades 2, 3, and 4. Only those students who took both a pretest and posttest were included in the data analysis. Teachers used the program for their math instruction five days per week and more than 25 minutes per day.

Instruction included the full year program. Pretests and posttests were written by math specialists based on the content and standards included in the program at each grade level. In addition to analyzing the gain scores for the total group of students at each grade, analyses were conducted separately for higher and lower pretest scoring mathematics students. Higher and lower scoring students were identified by the students' pretest scores. Those scoring highest on the pretests were designated as the high scoring mathematics students and those scoring lowest on the pretests were designated as the lower scoring math students.

The average gain scores for the total group of students at each grade were statistically significant. The effect sizes for all students at all grades were large.

In addition, the average gain scores for the low and high scoring groups at each grade level were also statistically significant. The effect sizes for the high and low scoring groups were large at all three grade levels. *All of the effect sizes at every grade exceeded by a large margin the effect sizes needed to determine a substantively important increase in scores.*

Overview of the Study

Houghton Mifflin Harcourt Publishers contracted with Educational Research Institute of America (ERIA) to conduct a full-year study to evaluate the effectiveness of the Go Math! Program for elementary school students. The study compared assessments administered to students in early September 2015 and about mid-June 2016.

Research Questions

The following research questions guided the design of the study and the data analyses:

- Does the implementation of *Go Math! Elementary Program* in grades 2-4 program lead to improved student mathematics achievement?
- Does the implementation of *Go Math! Elementary Program in grades* 2-4 lead to differential effects on student achievement as a function of student ability level?

Design of the Study

The design of the program called for the implementation of the Go Math! © program for grade 2, 3, and 4 students during the 2015–2016 academic year. A total of 92 teachers in 4 different states participated in the study. The number of teachers at each grade included:

- Grade 2: 9 schools; 4 states; 38 teachers.
- Grade 3: 10 schools; 4 states; 27 teachers.
- Grade 4: 9 schools; 4 states; 27 teachers.

Teachers reported using the program 5 days a week with an average usage time of more than 25 minutes.

Program Overview

Houghton Mifflin Harcourt GO Math! 2015© is a K–6 program written specifically to support the Common Core State Standards for Mathematics with an emphasis on developing 21st-century skills. The Standards for Mathematical Practice are integrated into the content, along with an equal emphasis on conceptual fluency. The program provides rigor, depth of understanding through interactive lessons, research-based instructional approaches, best practices, English learner support, and differentiated instructional resources to ensure success for all students. The comprehensive digital resources promote college and career readiness and support students, teachers, administrators, and parents.

GO Math! K–6

Incorporates Mathematical Practices in every lesson so students develop the mathematical thinking they need.

Features exploration-driven lessons that begin with problem-based situations and build to more abstract problems.

Elevates depth of understanding so students are ready for the rigor of CCSS and the Smarter Balanced Assessment.

Description of the Assessments

The pretest and posttest used in the study were developed by ERIA mathematics curriculum experts. Tests were developed to match the content of the Go Math! program used in the study as well as to emphasize the National Council of Teachers of Mathematics (NCTM) Standards.

The tests were developed to respond to the following emphases:

Innovative items that call for actual performance on the part of students that encourage divergent thinking and problem solving, emphasize on thinking skills, and align with the NCTM Standards and the State Common Core Standards.

The tests included both multiple choice and written responses as indicated below:

Grade	*Multiple-Choice Items*	*Student Supplied Answers*	*Total*
2	27	15	42
3	26	11	37
4	27	13	40

Table 1 provides the basic test statistics. The table shows that the reliabilities of the tests are high and provide adequate stability to assess mathematics achievement.

Table 1
Pretest and Posttest Statistics for the *Go Math!* Students
Grades 2, 3, and 4

Test	***Mean Score***	***Standard Deviation***	***KR 20***	***SEm****
Grade 2 Post-test	335	30.51	.80	13.64
Grade 3 Post-test	336	39.27	.68	22.12
Grade 4 Post-test	331	43.19	.81	18.83

**SEm stands for Standard Error of Measurement.*

Description of the Study Sample

Table 2 provides the demographic characteristics of the schools included in the study. It is important to note that the school data does not provide a description of the make- up of the classes that participated in the study. However, the data does provide a general description of the schools and, thereby, an estimate of the make-up of the classes included in the study.

The percentage of students enrolled in free/reduced lunch programs ranged from 3% to 89% and averaged 41% across the sample of schools. By comparison, the reported national average for students enrolled in free/reduced lunch programs in public schools was reported as 48.1%.[1]

The percentage of students classified as non-Caucasian ranged from 7% to 92% with an average of 41%. By comparison, 49.8% of the students enrolled in U.S. public schools were classified as non-Caucasian[2].

[1] *The National Center for Educational Statistics* (NCES) reported that for the 2011–2012 school year, 48.1% of public school students were enrolled in free/reduced lunch programs. No free/reduced lunch data were available for the 2012–2013 school year. Also, the NCES reported that for the 2012–2013 school year, 49.8% of public school students were classified as minority (non-Caucasian) students.

Table 2
Demographic Description of the Schools Included in the Study

State	Location	Grades	Enrollment	Non-Caucasian	% Free/Reduced Lunch
KS	Rural	PK to 2	551	25%	67%
KS	Rural	PK to 8	608	24%	56%
MI	Suburban	PK to 5	424	9%	5%
MI	Suburban	PK to 5	438	7%	3%
MI	Suburban	PK to 5	393	9%	6%
NJ	Suburban	PK to 3	662	92%	89%
NJ	Suburban	K to 5	421	56%	46%
NJ	Suburban	PK to 5	477	66%	44%
PA	Suburban	K to 5	548	43%	32%
PA	Suburban	K to 5	583	74%	64%
Average			511	41%	41%

Data Analyses and Results

Standard scores were used for all data analyses. Raw scores were converted to standard scores with a mean of 300 and a standard deviation of 50. Data analyses and descriptive statistics were computed for the students' standard scores.

For most of the comparisons, paired comparison *t*-tests were used to determine if differences in pretest and post test scores were significantly different. The comparisons were conducted for differences between the Go Math! September 2015 (pretest) and the Go Math! June 2016 (post-test). The ≤.05 level of significance was used as the level at which differences would be considered statistically significant.

In addition, effect size (Cohen's *d*) was computed for each of the comparisons. This statistic provides an indication of the strength of the effect of the treatment regardless of the statistical significance. Beyond the level considered to be substantively important, interpretations of effect sizes in this report include the following guidelines:

.20 to .49 = small
.50 to .79 = medium
.80+ = large

Grade 2 Results

Table 3 shows that the average scores of the 959 grade students participating in the study increased their average test scores at a statistical significant level. The effect size was substantively important and is classified as large.

Table 3
Grade 2 Total Group Paired Comparison *t*-test Results
Pretest/Posttest Standard Score Comparisons

	Number Students	***Mean Standard Score***	***SD***	***t*-test**	***Significance***	***Effect Size***
Pretests	959	266	41.1	51.818	≤.0001	1.98
Post-tests	959	335	30.5			

The total group of 959 grade 2 students was divided into two approximately equal sized groups based on their pretest scores. The 480 students scoring lowest on the pretest were considered to be lower achieving mathematics students while the 479 scoring highest on the pretest scores were considered to be higher achieving mathematics students.

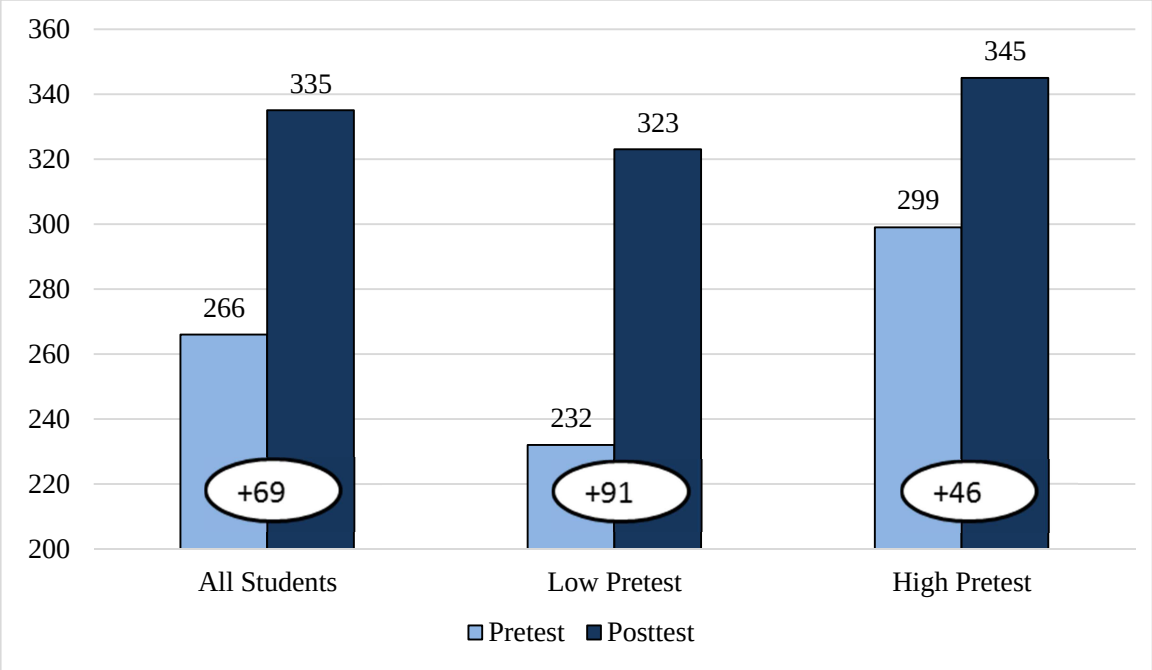
Table 4 shows that both groups made statistically significant gains. The effect sizes for both groups were substantively important and are classified as large.

Table 4
Grade 2 Paired Comparison *t*-test Results
High- and Low-Scoring Pretest Groups

Test	***Number of Students***	***Mean Standard Score***	***SD***	***t-test***	***Significance***	***Effect Size***
Lower Scoring Group						
Pretest	480	232	22.8	52.529	≤0001	3.28
Posttest	480	323	32.3			
Higher Scoring Group						
Pretest	479	299	24.8	33.626	≤0001	1.89
Posttest	479	345	24.2			

Figure 1 provides a graphic representation of the gains achieved by the grade 2 students. In this full year study, the grade 2 students increased their average scores by 69 standard score points The low achieving mathematics students increased their scores 91 points while the high achieving mathematics students increased their scores 46 points.

Figure 1
Grade 2 Pretest Posttest Gain Comparison
All Students, Low Pretest Students, High Pretest Students



Grade 3 Results

Table 5 shows that the average scores of the 723 grade 3 students participating in the study increased their average test scores at a statistical significant level. The effect size was substantively important and is classified as large.

Table 5
Grade 3 Total Group Paired Comparison *t*-test Results
Pretest/Posttest Standard Score Comparisons

	Number Students	***Mean Standard Score***	***SD***	***t*-test**	***Significance***	***Effect Size***
Pretests	723	264	29.1	54.038	≤.0001	2.09
Post-tests	723	336	39.3			

Based on their pretest scores, the total group of 723 grade 3 students was divided into two approximately equal sized groups. The 361 students scoring lowest on the pretest were considered to be lower achieving mathematics students while the 362 students scoring highest on the pretest scores were considered to be higher achieving mathematics students.

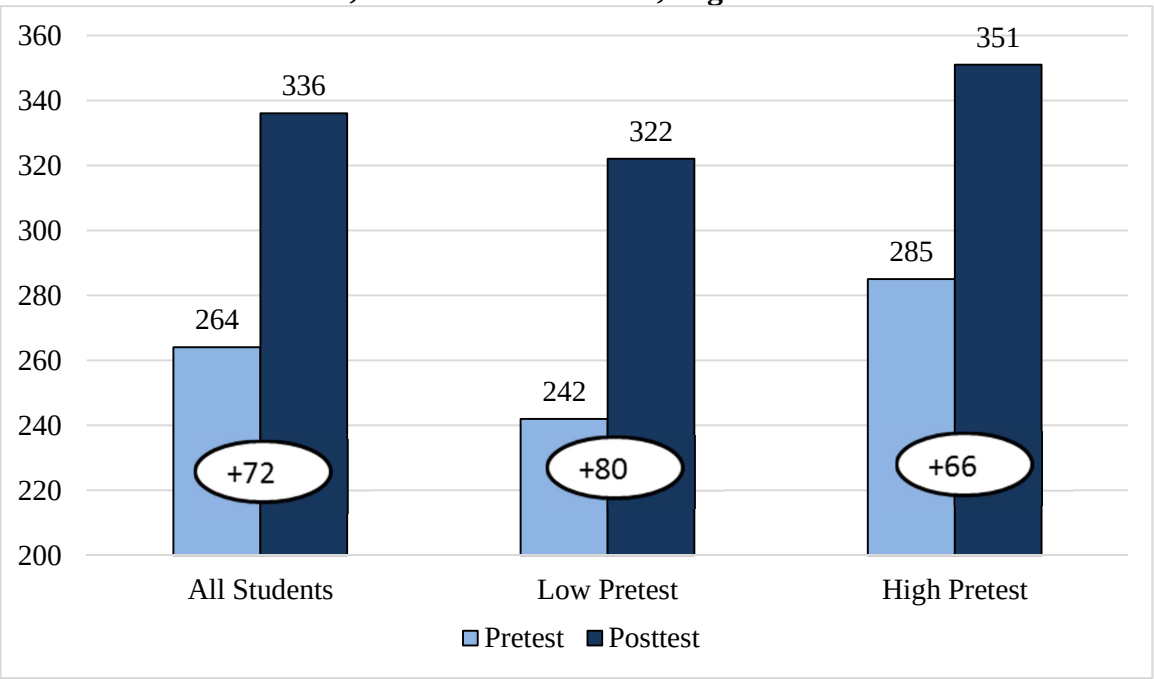
Table 6 shows that both groups made statistically significant gains. The effect sizes for both groups were substantively important and are classified as large.

Table 6
Grade 3 Paired Comparison *t*-test Results
High- and Low-Scoring Pretest Groups

Test	***Number of Students***	***Mean Standard Score***	***SD***	**t-*test***	***Significance***	***Effect Size***
Lower Scoring Group						
Pretest	361	242	10.9	39. 659	≤0001	2.76
Posttest	361	322	39.2			
Higher Scoring Group						
Pretest	362	285	25.3	38.291	≤0001	2.20
Posttest	362	351	33.5			

Figure 2 provides a graphic representation of the gains achieved by the grade 3 students. In this full academic year study, the grade 3 students increased their average scores by 72 standard score points. The low achieving mathematics students increased their scores by 80 standard score points while the high achieving mathematics students increased their scores by 66 standard score points.

Figure 2
Grade 3 Pretest Posttest Gain Comparison
All Students, Low Pretest Students, High Pretest Students



Grade 4 Results

Table 7 shows that the average scores of the 591 grade 4 students participating in the study increased their average test scores at a statistical significant level. The effect size was substantively important and is classified as large.

Table 7
Grade 4 Total Group Paired Comparison t-test Results
Pretest/Posttest Standard Score Comparisons

	Number Students	***Mean Standard Score***	***SD***	***t-test***	***Significance***	***Effect Size***
Pretests	591	269	34.8	44.055	≤.0001	1.58
Post-tests	591	331	43.2			

The total group of 591 grade 4 students was divided into two equal sized groups based on their pretest scores. The 295 students scoring lowest on the pretest were considered to be lower achieving mathematics students while the 296 scoring highest on the pretest scores were considered to be higher achieving mathematics students.

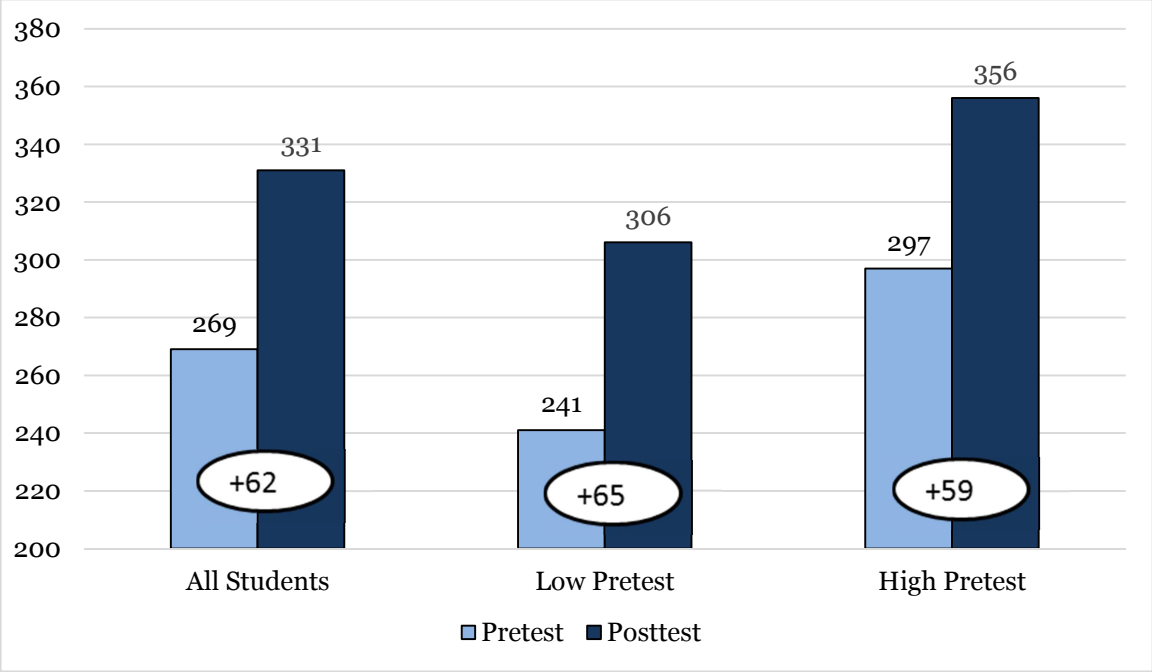
Table 8 shows that both groups made statistically significant gains. The effect sizes for both groups were substantively important and are classified as large for the low scoring group and medium for the high scoring group.

Table 8
Grade 4 Paired Comparison *t*-test Results
High- and Low-Scoring Pretest Groups

Test	**Number of Students**	**Mean Standard Score**	**SD**	**t-test**	**Significance**	**Effect Size**
Lower Scoring Group						
Pretest	295	241	16.4	30.436	≤0001	2.18
Posttest	295	306	39.2			
Higher Scoring Group						
Pretest	296	297	24.1	32.565	≤0001	2.09
Posttest	296	356	31.4			

Figure 3 provides a graphic representation of the gains achieved by the grade 4 students. In this full academic year study, the grade 4 students increased their average standard scores by 62 points. The low achieving mathematics students increased their scores by 65 standard score points while the high achieving mathematics students increased their scores by 59 standard score points.

Figure 3
Grade 4 Pretest Posttest Gain Comparison
All Students, Low Pretest Students, High Pretest Students



Conclusions

This study sought to determine the effectiveness of the Go Math! K-6 grades mathematics program by comparing growth on reliable and valid pretests and posttests. The study took place during the 2015-2016 academic year and was carried out in 4 states and included 10 different schools and 92 teachers. The student population included the 41% of students eligible for the free/reduced price which was about 7% as the national average. The percentage of non-Caucasian student was 41% which is about 9% lower than the national average.

Two research questions guided the study and the conclusions for each are reported below.

Research Question 1

- *Does the implementation of Go Math! Elementary Program in grades 2-4lead to improved student mathematics achievement?*

Across all three grades mathematics student growth was statistically significant. The effect sizes at all three grades were above a substantively important level and were large.

Research Question 2

- *Does the implementation of Go Math! Elementary Program in grades 2-4 lead to differential effects on student achievement as a function of student ability level?*

Across all three grades mathematics student growth for the high achieving and low achieving students was statistically significant. The effect sizes at all grades for both the high and low group students were above a substantively important level and were large at all grade levels.