Educational Research
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A STUDY OF THE INSTRUCTIONAL EFFECTIVENESS OF *GO MATH!*

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Contents

ABSTRACT

Educational Research Institute of America was commissioned by Houghton Mifflin Harcourt to conduct a one-year efficacy study of the brand new elementary mathematics program Go Math! in several Florida classrooms. The study lasted a complete academic year from September 2010 to May 2011. A pretest/posttest design was employed using tests which were developed by researchers for use in the study. Students from five different schools participated in the study which was conducted at grades 3, 4 and 5. At grade 3, 18 classes formed the experimental group (using the ***Go Math!*** *program) and 5 classes formed the control group, which continued to use their previous program of study. At grade 4, there were 15* ***Go Math!*** *classes and 4 control group classes. At grade 5, there were 14* ***Go Math!*** *classes and 4 control group classes.*

All participating teachers either volunteered to participate in the study or were asked to participate by school administrators. An examination of the demographic characteristics of the five participating schools indicates they are similar in terms of the percentage of students enrolled in free/reduced lunch programs and other characteristics. This school-level data does not necessarily mean that the classes are similar, but it does provide an indication that such is

The results showed that both the control group classes and the ***Go Math!*** *group classes made significant gains over the course of the semester. The effect sizes were large for the Mathematics total results. The results also show consistent evidence at both grades 3, 4, and 5 that the* ***Go Math!*** *students made greater gains over the course of the semester than did the control group students. Finally, the analysis clearly showed that the* ***Go Math!*** *program proved equally effective with both higher and lower pretest scoring students.*

Overview of the Study

Recent federal initiatives have focused attention on mathematics instruction to improve student achievement. Since the passing of the No Child Left Behind legislation and the National Math Panel Report, the demand on schools to implement mathematics programs and practices that are grounded in scientifically based research with proven efficacy has been more important than ever. This demand has extended to educational publishers who develop mathematics materials.

Because of its importance to a student's overall academic success, mathematics is viewed by educators and the public as particularly important. As a result, educators have become increasingly interested in students' achievement levels in mathematics. International studies have shown that students in many countries outperform American students on assessments of mathematics. In order to evaluate the program's effectiveness Houghton Mifflin Harcourt Publishers contracted with the Educational Research Institute of America to conduct a study to test the effectiveness of the new GO Math! program in several school districts in Florida.

This report describes a full year instructional efficacy study conducted in the state of Florida to determine the impact of ***Go Math!***, a Kindergarten through grade 6 mathematics program published by Houghton Mifflin Harcourt Publishers.

Research Questions

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

1. Is ***Go Math!*** effective in improving the mathematics skills and problem solving strategies of elementary grade level students?
2. Is ***Go Math!*** more effective than an alternative program in improving the mathematics skills and problem solving strategies of elementary grade level students?
3. Is ***Go Math!*** effective in improving the mathematics skills and problem solving strategies of lower performing as well as higher performing elementary grade level students?

Design of the Study

The program's efficacy was evaluated using a pretest/posttest design with an experimental (***Go Math!***) and a control group. Before program instruction, control group and ***Go Math!*** group students were administered a comprehensive test designed to cover the content expected to be covered over the course of the academic year at each grade level, as well as to match the standards established by the National Council of Teachers of Mathematics (NCTM).

Study Participants

The study was conducted in five different schools in Florida. The program effectiveness data reported here is based on a sample which included the following numbers of teachers and schools:

Grade 3

5 different schools
18 ***GO MATH!*** classes
5 control classes

Grade 4

5 different schools
15 ***GO MATH!*** classes
4 control classes

Grade 5

5 different schools
14 ***GO MATH!*** classes
4 control classes

In all, five different schools and a total of 60 different teachers in Florida are included in the study sample whose results are described in this report.

Timeline and Program Use

All ***GO MATH!*** teachers used the program for a full school year. This was the first time the teachers had used the program and most were unfamiliar with the program prior to the tryout. The control group teachers used the same mathematics program in use in their district.

Instructional Approach under Study

Following is a description of the program provided by the publisher:

> ***GO Math!*** *is a* ***new*** *comprehensive Kindergarten—Grade 6 mathematics program developed to support the Common Core State Standards for Mathematics and the NCTM Curriculum Focal Points. The program emphasizes Big Ideas and depth of understanding through interactive lessons, research based instructional approaches, best practices from around the world, and differentiated instructional resources to ensure success for all students.*
>
> *The unique* ***GO Math!*** *write-in student edition helps students interact with lessons in new ways. Students record their strategies, explanations, solutions, practice and test prep right in their books—and at every grade level. These interactive lessons keep students totally engaged and maximize learning during math time.*
>
> *And* ***GO Math!*** *works for the busy teacher. Everything from teacher editions organized in slim and trim chapter books to manipulatives and differentiated centers is organized for you to find what you need, when you need it. And, most of our components come ready-made, in a grab and go organization to save you time.*

Description of the Research Sample

Tables 1 and 2 provide demographic summaries of the schools included in the study. The two tables show the control group and the experimental group (***Go Math!)*** schools separately for grades 3, 4 and 5. An examination of Tables 1 and 2 reveals the averages are generally similar.

It is important to note that the school data does not provide a description of the make-up of each of the classes that participated in the study. However, the tables do provide general descriptions of the schools and, thereby, an estimate of the make-up of the classes that comprised the sample.

Table 1
Demographic Characteristics
Grade 3, 4, and 5 Control Group School Included in the Study

Location	*Grades*	*Students Enrolled*	*% Students Free/Reduced Lunch Programs*	*% Minority*	*% Students with Special Education Needs*
Mid-Size Central City	K to 5	753	50%	40%	15%

Table 2
Demographic Characteristics
Grade 3, 4, and 5 *GO MATH!* Group Schools Included in the Study

Location	*Grades*	*Students Enrolled*	*% Students Free/Reduced Lunch Programs*	*% Minority*	*% Students with Special Education Needs*
Urban Fringe of Large City	K to 5	756	22%	28%	17%
Urban Fringe of Large City	K to 5	747	71%	13%	22%
Urban Fringe of Large City	K to 5	896	19%	25%	10%
Urban Fringe of Large City	K to 5	979	22%	38%	10%
Averages		**845**	**33%**	**26%**	**15%**

Description of the Assessments

The pretest and posttest used in the study were developed by mathematics curriculum experts hired by the Educational Research Institute of America. Tests were developed to generally match the content expected to be covered over the course of the academic year and to emphasize the National Council of Teachers of Mathematics (NCTM) Standards.

More specifically 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
- Emphasis on thinking skills
- Alignment with the NCTM Standards and the State Common Core Standards

The grade 3 test included 40 multiple-choice items. The grade 4 tests included 34 multiple-choice items and 6 open-ended items worth a total of 6 points. The grade 5 test included 29 multiple-choice items and 11 open-ended items worth a total of 11 points. Thus, each test had a maximum raw score of 40 points.

Table 3 provides the basic test statistics for the multiple choice test items only. At grade 3 there were no open-ended items. However at grade 4 there were an additional 6 points for open-ended questions and at grade 5 there were an additional 11 points for open-ended questions. The tables show that the reliabilities of the tests are high and provide adequate stability to assess mathematics achievement.

Table 3
Posttest Statistics for the *Go Math!* and Control Students
Grades 3, 4, and 5

Test	*Number of Items*	*Mean Score*	*Standard Deviation*	*KR 20*	*SEm**
Grade 3: ***Go Math!*** and Control	40	24.8	7.01	.86	2.6
Grade 4: ***Go Math!*** and Control	34	21.8	5.7	.83	2.3
Grade 5: ***Go Math!*** and Control	29	17.07	6.03	.85	2.1

**SEm means Standard Error of Measurement.*

Data Analyses

Data analyses and descriptive statistics were computed for the Mathematics tests developed for each grade level. Raw scores were converted to standard scores using a mean of 300 and a standard deviation of 50. This was done so the scores approximated a more normal distribution.

The $\leq$.05 level of significance was used as the level at which increases would be considered statistically significant for all of the statistical tests.

The following statistical analyses were conducted to compare students' pretest standard scores to posttest standard scores at grades 3, 4, and 5:

- A paired comparison *t*-test was used to compare the pretest mean standard scores with the posttest mean standard scores for all students.
- A mixed model analysis of variance was computed to determine if there was a significant interaction between the two groups and pretest/posttest scores.
- Based on the significant finding with the mixed model analysis of variance, independent sample pretest analyses were computed to determine if there were significant differences between the ***Go Math!*** group and the control group at pretesting and posttesting.
- Paired comparison t-tests were used to compare the pretest and posttest scores for the control group and a second set of t-tests were used to compare the pretest and posttest scores for the **Go Math!** group.
- The ***Go Math!*** group at each grade level was split into two groups based on pretest scores. Paired comparison *t*-tests were used with the group that scored highest and the group that scored lowest on the pretest to compare pretest-to-posttest performance. This was done to determine if the program proved to be equally effective with low performers and high performers.

An effect-size analysis was computed for each of the independent sample and paired *t*-test paired comparisons. Cohen's *d* statistic was used to determine the effect size. This statistic provides an indication of the strength of the effect of the treatment regardless of the statistical significance. Cohen's *d* statistic is interpreted as follows:

.2 = small effect
.5 = medium effect
.8 = large effect

Grade Three Data and Analyses

Total Group Analysis

Researchers at ERIA conducted a paired comparison *t*-test to determine if the difference from pretest standard scores to posttest standard scores was statistically significant for the total mathematics test. Standard scores were used for the analysis. Those were computed to provide a more normal distribution of raw scores. The mean of the standard score scale is 300 and the standard deviation is 50.

For this analysis, researchers were able to match the pretest and posttest scores for 360 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 4 shows that the average standard score on the Total Mathematics pretest was 267 and the average standard score on the posttest was 333. The increase from pretest to posttest was statistically significant at the ≤.0001 level. The effect size was large.

Table 4
Grade 3 Total Group Paired Comparison *t*-test Results
Pretest/Posttest Comparison of Total Mathematics Standard Scores

Test	*Number Students*	*Mean Standard Score*	*SD*	*t*-test	*Significance*	*Effect Size*
Total Mathematics	360	267	30.5	33.885	≤.0001	1.80
Total Mathematics	360	333	42.8			

Go Math! Group and Control Group Analyses

In order to test for the significance of the particular program used, a Repeated Measures Model Analysis of Variance was conducted with the ***Go Math!*** and Control group as the between subject variable and pretest and posttest scores as the within subject variable. Table 5 shows that the within subject variable (pretest/posttest scores) was statistically significant (≤.0001). In addition, the interaction of treatment group (***Go Math!*** or Control) and the pretest/posttest was also significant (≤.0001).

Table 5
Repeated Measures Model Analysis of Variance
To Test the Interaction of *Go Math!*/Control Group as a Between Subjects Factor and Pretest/Posttest Scores as a Within Subjects Factor

Test	*Mean Square*	F-*test*	*Significance*
Pretest/Posttest Effects	378161	18871	≤.0001
Interaction Effect of Pretest/Posttest and Treatment Group	15782	14.266	≤.0001

Based on the finding that there was a significant interaction effect with pretest/posttest and ***Go Math!***/Control group, independent sample t-tests were computed to determine if significant differences existed between ***Go Math!*** and control group students on the pretests and posttests. The tests contrasted the students' performance on the Total Mathematics test using standard scores. Table 6 shows that on the pretest, the control group students and the ***Go Math!*** group students showed no statistically significant differences.

Table 6
Grade 3 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=294) and Control Group (N=66)
Students' Pretest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	t-*test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=294)	267	31.1	.327	Non-Significant	--
Total Mathematics	Control (N=66)	263	27.5			

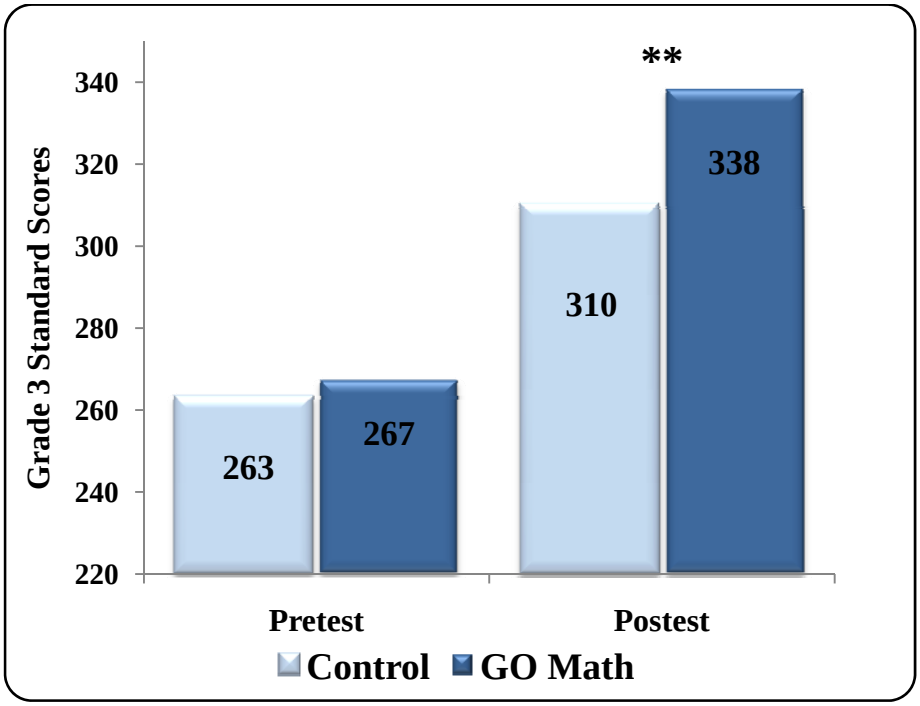
Table 7 provides the same analysis for the posttest scores. The difference between posttest scores for the ***Go Math!*** and the control groups reached statistical significance. The results indicate that while there was no statistically significant difference between the two groups at pretesting, the ***Go Math!*** group made greater gains over the course of the study and scored significantly higher on the posttests (≤.0001). The effect size for the difference was medium.

Table 7
Grade 3 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=294) and Control Group (N=66)
Students' Posttest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=294)	338	40.9	5.024	≤.0001	.67
Total Mathematics	Control (N=66)	310	43.9			

Figure 1 depicts the results of the Repeated Measures ANOVA for Grade 3 Students indicating that there was a significant difference between **Go Math!** Students and Control Students only on the Posttest Scores.

Figure 1
Grade 3 Results of the Repeated Measure ANOVA



***Indicates Standard Scores are significantly different at p < .0001*

Pretest and Posttest Differences for *Go Math!* Group and Control Group

To determine the actual gains made by the control and ***Go Math!*** groups over the course of the year paired comparison *t*-tests were computed for both groups for the Total Mathematics standard scores. Table 8 provides the pretest and posttest standard scores. The difference for both groups was statistical significant. The effect size was large for the control group and for the ***Go Math!*** group.

Table 8
Grade 3 Paired Comparison *t*-test Results for Pretest/Posttest Comparisons of the Standard Scores for the Control Group and the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Control Group							
Total Mathematics	Pretest	66	263	27.5	10.201	≤.0001	1.30
Total Mathematics	Posttest	66	310	43.9			
***Go Math!* Group**							
Total Mathematics	Pretest	294	267	31.1	33.942	≤.0001	1.98
Total Mathematics	Posttest	294	338	40.9			

Go Math! High and Low Scoring Students

Another analysis was conducted with the ***Go Math!*** group to determine if students who scored lower on the pretest made gains as great as those students who scored higher on the pretest. For this analysis students were ranked in order on the basis of their pretest Total Mathematics standard scores. The group of 294 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 147 students in the lower scoring group and their average standard score on the pretest was 243, with scores ranging from 176 to 269. The higher scoring group included 147 students and their average standard score on the pretest was 292, with scores ranging from 269 to 388.

Pretest-to-posttest standard score comparisons are shown in Table 9 for the lower and higher pretest scoring students in the ***Go Math!*** group. Scores were analyzed using a paired comparison *t*-test to determine if the high pretest scoring group and the low pretest scoring group both made significant gains.

The pretest-to-posttest increases in average standard scores for both the lower and higher pretest group students were significant (≤.0001). The effect sizes for both the high scoring and low scoring pretest groups were large.

Table 9
Grade 3 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Groups in the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Lower Scoring Group							
Total Mathematics	Pretest	147	243	15.9	25.341	≤0001	2.79
Total Mathematics	Posttest	147	322	38.0			
Higher Scoring Group							
Total Mathematics	Pretest	147	292	21.9	23.806	≤0001	2.17
Total Mathematics	Posttest	147	355	36.7			

Grade Four Data and Analyses

Total Group Analysis

Researchers at ERIA conducted a paired comparison *t*-test to determine if the difference from pretest standard scores to posttest standard scores was statistically significant for the total mathematics test. Standard scores were used for the analysis. Those were computed to provide a more normal distribution of raw scores. The mean of the standard score scale is 300 and the standard deviation is 50.

For this analysis, researchers were able to match the pretest and posttest scores for 346 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 10 shows that the average standard score on the Total Mathematics pretest was 264 and the average standard score on the posttest was 336. The increase from pretest to posttest was statistically significant at the ≤.0001 level. The effect size was large.

Table 10
Grade 4 Total Group Paired Comparison *t*-test Results
Pretest/Posttest Comparison of Total Mathematics Standards Scores

Test	*Number Students*	*Mean Standard Score*	*SD*	*t*-test	*Significance*	*Effect Size*
Total Mathematics	346	264	28.0	40.207	≤.0001	2.11
Total Mathematics	346	336	40.6			

Go Math! Group and Control Group Analyses

In order to test for the significance of the particular program used, a Repeated Measures Model Analysis of Variance was conducted with the ***Go Math!*** and Control group as the between subject variable and pretest and posttest scores as the within subject variable. Table 11 shows that the within subject variable (pretest/posttest scores) was statistically significant (≤.0001). In addition, the interaction of treatment group (***Go Math!*** or Control) and the pretest/posttest was also significant (≤.0001).

Table 11
Repeated Measures Model Analysis of Variance
To Test the Interaction of *Go Math!*/Control Group as a Between Subjects Factor and Pretest/Posttest Scores as a Within Subjects Factor

Test	*Mean Square*	F-*test*	*Significance*
Pretest/Posttest Effects	382987	714.2	≤.0001
Interaction Effect of Pretest/Posttest and Treatment Group	6841	12.8	≤.0001

Based on the finding that there was a significant interaction effect with pretest/posttest and ***Go Math!*** and Control group, independent sample t-tests were computed to determine if significant differences existed between ***Go Math!*** and control group students on the pretests and posttests. The tests contrasted the students' performance on the Total Mathematics test using standard scores. Table 12 shows that on the pretest, the control group students and the ***Go Math!*** group students' scores were significantly different (≤.03); however, the effect size was small.

Table 12
Grade 4 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=294) and Control Group (N=53)
Students' Pretest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	t-*test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=294)	265	27.9	2.186	≤.03	.34
Total Mathematics	Control (N=52)	256	26.8			

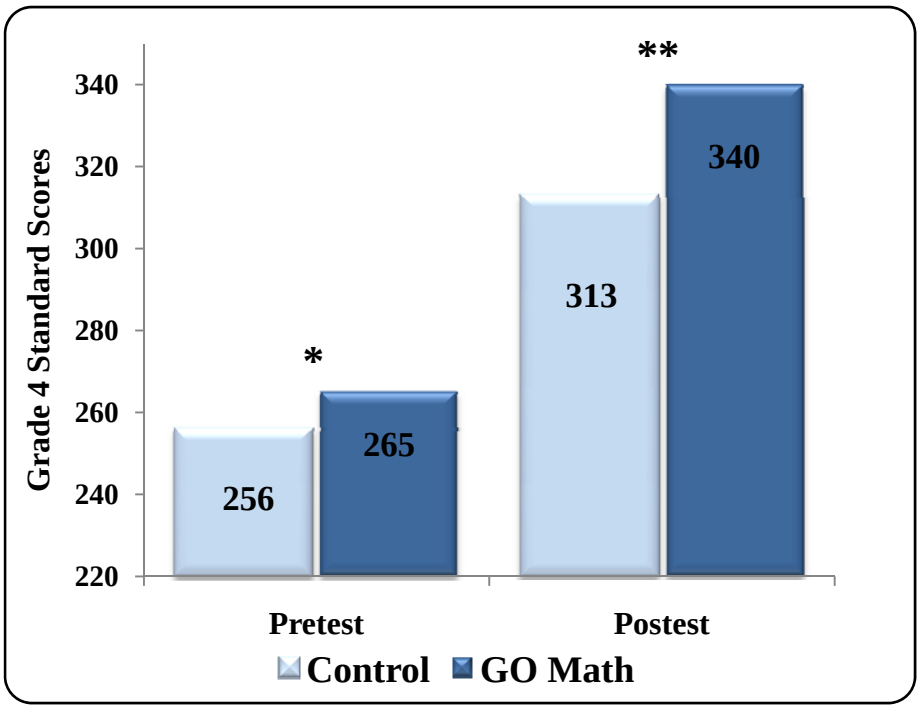
Table 13 provides the same analysis for the posttest scores. The difference between posttest scores for the ***Go Math!*** and the control groups reached statistical significance (≤ .0001). The results indicate that while there was a significant difference between the two groups at pretesting, the ***Go Math!*** group made greater gains over the course leading to significantly greater posttest scores at the end of the study. The effect size for the difference was medium.

Table 13
Grade 4 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=294) and Control Group (N=53)
Students' Posttest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	t-*test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=294)	339	40.0	4.288	≤.0001	.64
Total Mathematics	Control (N=52)	314	39.0			

Figure 2 depicts the results of the Repeated Measures ANOVA for Grade 4 Students representing the interaction between Group (Go Math!, Control) and Test (Pretest, Posttest).

Figure 2
Grade 4 Results of the Repeated Measures ANOVA



**Indicates Standard Scores Significantly different at p ≤ .05*
*** Indicates Standards Scores Significantly different at p ≤ .0001*

Pretest and Posttest Differences for Control and Go Math! Groups

To determine the actual gains made by the control and ***Go Math!*** groups over the course of the year paired comparison *t*-tests were computed for both groups for the Total Mathematics standard scores. Table 14 provides the pretest and posttest standard scores and the *t*-test analyses as well as the effect sizes for both the control group students and the ***Go Math!*** group students. The results show that the comparisons for both the control and the ***Go Math!*** group were statistically significant (≤.0001). The effect size was large for both the control group and the ***Go Math!*** group.

Table 14

Grade 4 Paired Comparison *t*-test Results for Pretest/Posttest Comparisons of the Standard Scores for the Control Group and the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Control Group							
Total Mathematics	Pretest	52	256	27.0	12.285	≤.0001	1.70
Total Mathematics	Posttest	52	313	39.3			
***Go Math!* Group**							
Total Mathematics	Pretest	294	265	27.9	39.227	≤.0001	2.20
Total Mathematics	Posttest	294	340	39.6			

Go Math! High and Low Scoring Students

Another analysis was conducted with the ***Go Math!*** group to determine if students who scored lower on the pretest made gains as great as those students who scored higher on the pretest. For this analysis students were ranked in order on the basis of their pretest Total Mathematics standard scores. The group of 294 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 147 students in the lower scoring group and their average standard score on the pretest was 243, with scores ranging from 205 to 267. The higher scoring group included 147 students and their average standard score on the pretest was 287, with scores ranging from 261 to 355.

Pretest-to-posttest standard score comparisons are shown in Table 15 for the lower and higher pretest scoring students in the ***Go Math!*** group. Scores were analyzed using a paired comparison *t*-test to determine if the high pretest scoring group and the low pretest scoring group both made significant gains.

The pretest-to-posttest increases in average standard scores for both the lower and higher pretest group students were significant at the ≤.0001 level, indicating a difference that would have occurred by chance less than once out of 10,000 repetitions. The effect sizes for both the high scoring and low scoring pretest groups were large.

Table 15
Grade 4 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Groups in the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Lower Scoring Group							
Total Mathematics	Pretest	147	243	13.7	26.999	≤0001	2.88
Total Mathematics	Posttest	147	321	36.4			
Higher Scoring Group							
Total Mathematics	Pretest	147	287	19.8	29.060	≤0001	2.63
Total Mathematics	Posttest	147	358	33.4			

Grade Five Data and Analyses

Total Group Analysis

Researchers at ERIA conducted a paired comparison *t*-test to determine if the difference from pretest standard scores to posttest standard scores was statistically significant for the total mathematics test. Standard scores were used for the analysis. Those were computed to provide a more normal distribution of raw scores. The mean of the standard score scale is 300 and the standard deviation is 50.

For this analysis, researchers were able to match the pretest and posttest scores for 347 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 16 shows that the average standard score on the Total Mathematics pretest was 268 and the average standard score on the posttest was 332. The increase from pretest to posttest was statistically significant (≤.0001). The effect size was large.

Table 16
Grade 5 Total Group Paired Comparison *t*-test Results
Pretest/Posttest Comparison of Standard Scores
for Total Mathematics Scores

Test	*Number Students*	*Mean Standard Score*	*SD*	*t*-test	*Significance*	*Effect Size*
Total Mathematics	347	268	31.8	37.341	≤.0001	1.73
Total Mathematics	347	332	43.8			

Go Math! Group and Control Group Analyses

In order to test for the significance of the particular program used, a Repeated Measures Model Analysis of Variance was conducted with the ***Go Math!*** and Control group as the between subject variable and pretest and posttest scores as the within subject variable. Table 17 shows that the within subject variable (pretest/posttest scores) was statistically significant (≤.0001). In addition, the interaction of treatment group (***Go Math!*** or Control) and the pretest/posttest was also significant (≤.0001).

Table 17
Repeated Measures Model Analysis of Variance
To Test the Interaction of *Go Math!*/Control Group as a Between Subjects Factor and Pretest/Posttest Scores as a Within Subjects Factor

Test	*Mean Square*	F-*test*	*Significance*
Pretest/Posttest Effects	380467	820.503	≤.0001
Interaction Effect of Pretest/Posttest and Treatment Group	18123	39.084	≤.0001

Based on the finding that there was a significant interaction effect with pretest/posttest and ***Go Math!***/Control group, independent sample t-tests were computed to determine if significant differences existed between ***Go Math!*** and control group students on the pretests and posttests. The tests contrasted the students' performance on the Total Mathematics test using standard scores. Table 18 shows that on the pretest, the control group students and the ***Go Math!*** group students showed no statistically significant differences.

Table 18
Grade 5 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=273) and Control Group (N=74)
Students' Pretest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	t-*test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=273)	268	32.6	.386	Non-Significant	--
Total Mathematics	Control (N=74)	266	29.1			

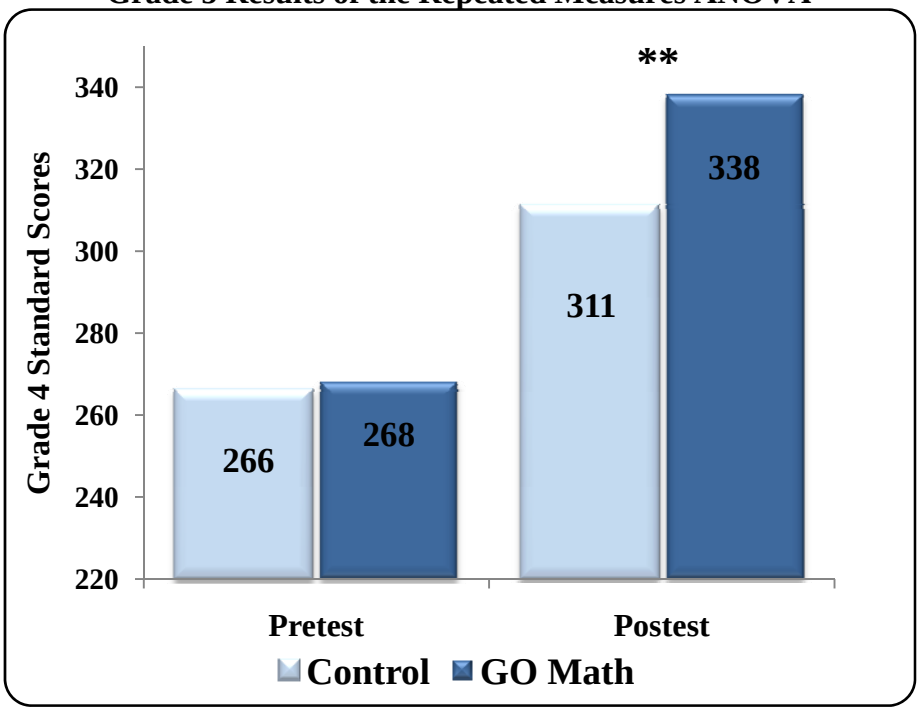
Table 19 provides the same analysis for the posttest scores. The difference between posttest scores for the ***Go Math!*** and the control groups reached statistical significance. The results indicate that while there was no statistically significant difference between the two groups at pretesting, the ***Go Math!*** group made greater gains over the course of the study and scored significantly higher on the posttests than the control. The difference was significant at the ≤.0001 level of significance. The effect size for the difference was medium.

Table 19
Grade 5 Independent Sample Comparison *t*-test Results
Comparing the *Go Math!* Group (N=351) and Control Group (N=84)
Students' Posttest Standard Scores

Test	*Group*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Total Mathematics	***Go Math!*** (N=273)	338	41.3	4.766	≤.0001	.60
Total Mathematics	Control (N=74)	311	46.9			

Figure 3 depicts the results of the Repeated Measures ANOVA for Grade 5 Students indicating that there was a significant difference between **Go Math!** Students and Control Students only on the Posttest Scores.

Figure 3
Grade 5 Results of the Repeated Measures ANOVA



** *Indicates Standards Scores Significantly different at p ≤ .0001*

Pretest and Posttest Differences for Control and *Go Math!* Groups

To determine the actual gains made by the control and ***Go Math!*** groups over the course of the year paired comparison *t*-tests were computed for both groups for the Total Mathematics standard scores. Table 20 provides the pretest and posttest standard scores and the *t*-test analyses as well as the effect sizes for both the control group students and the ***Go Math!*** group students.

The results show that the comparisons for both the control and the ***Go Math!*** group was ≤.0001 indicating a difference that would occur by chance less than once out of 10,000 repetitions. The effect size was large for both the control group and the ***Go Math!*** group.

Table 20
Grade 5 Paired Comparison *t*-test Results for Pretest/Posttest Comparisons of the Standard Scores for the Control Group and the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Control Group							
Total Mathematics	Pretest	74	266	29.1	11.670	≤.0001	1.18
Total Mathematics	Posttest	74	311	46.9			
***Go Math!* Group**							
Total Mathematics	Pretest	273	268	32.6	38.675	≤.0001	1.89
Total Mathematics	Posttest	273	338	41.3			

Go Math! High and Low Scoring Students

Another analysis was conducted with the ***Go Math!*** group to determine if students who scored lower on the pretest made gains as great as those students who scored higher on the pretest. For this analysis students were ranked in order on the basis of their pretest Total Mathematics standard scores. The group of 273 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 136 students in the lower scoring group and their average standard score on the pretest was 242, with scores ranging from 195 to 266. The higher scoring group included 137 students and their average standard score on the pretest was 294, with scores ranging from 266 to 372.

Pretest-to-posttest standard score comparisons are shown in Table 21 for the lower and higher pretest scoring students in the ***Go Math!*** group. Scores were analyzed using a paired comparison *t*-test to determine if the high pretest scoring group and the low pretest scoring group both made significant gains.

The pretest-to-posttest increases in average standard scores for both the lower and higher pretest group students were significant at the ≤.0001 level, indicating a difference that would have occurred by chance less than once out of 10,000 repetitions. The effect sizes for both the high scoring and low scoring pretest groups were large.

Table 21
Grade 5 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Groups in the *Go Math!* Group

Test	*Test Form*	*Number of Students*	*Mean Standard Score*	*SD*	*t-test*	*Significance*	*Effect Size*
Lower Scoring Group							
Total Mathematics	Pretest	136	242	15.5	23.700	≤0001	2.69
Total Mathematics	Posttest	136	311	33.7			
Higher Scoring Group							
Total Mathematics	Pretest	137	294	23.3	33.011	≤0001	2.62
Total Mathematics	Posttest	137	364	30.0			

Conclusions

This study sought to determine the effectiveness of ***Go Math!*** by comparing the performance of students using the program to the performance of students using alternative mathematics programs which were currently in use in their schools or comparable schools.

The study was carried out with classes at grades 3, 4, and 5. The grade 3 tryout included 18 ***Go Math!*** classes and 5 control group classes. The grade 4 tryout included 15 ***Go Math!*** classes and 4 control group classes. The grade 5 tryout included 14 ***Go Math!*** Classes and 4 control group classes. Teachers either volunteered or were asked to participate in the study. The ***Go Math!*** teachers were using the program for the first time and received no special instruction in using the program.

Three research questions guided the study:

1. Is ***Go Math!*** effective in improving the mathematics skills and problem solving strategies of elementary grade level students?
2. Is ***Go Math!*** more effective than an alternative program in improving the mathematics skills and problem solving strategies of elementary grade level students?
3. Is ***Go Math!*** effective in improving the mathematics skills and problem solving strategies of lower performing as well as higher performing elementary grade level students?

Question 1: Is Go Math! an effective program at grades 3, 4 and 5?

A valid and reliable mathematics test was used as the pretest and posttest instrument for control group students and ***Go Math!*** students. Paired comparison statistical tests showed that at all three grades the students in the ***Go Math!*** classes increased their scores statistically significantly and the effect sizes were large.

Question 2: Is Go Math! more effective than an alternative mathematics program in increasing mathematics skills and strategies?

At grades 3 and 5 comparative analyses of the mathematics pretest scores showed that the ***Go Math!*** students and the control group students showed no statistically significant differences in their average standard scores. At grade 4 there was a statistically significant difference ($\leq$.03). However, the posttest analyses at all three grade levels showed a statistically significant difference between the control group students and the ***Go Math!*** group students ($\leq$.0001). The ***Go Math!*** group students scored statistically significantly higher on the posttest scores when compared to the control group students.

The effect size differences for the differences between the ***Go Math!*** group and the control group were medium at all 3 grades.

Question 3: Is Go Math! equally effective in improving the mathematics skills and strategies of lower achieving students as well as higher achieving students?

At all three grade levels, the higher and lower pretest score groups were compared. Statistical analyses showed that both groups made statistically significant gains. Effect sizes were large for both higher and lower pretest scoring groups at all three grade levels.

Across all three grades, the conclusion for question 3 is positive. The Go Math! program increases the mathematics skills and strategies of both lower pretest scoring students and higher pretest scoring students.

The conclusion, based on the data collected and analyzed for students at three grade levels using both the Go Math! program and another national mathematics program, is that students at all three grade levels made significant gains over the course of the year. These gains can, of course, in part be attributed to excellent teaching as well as the mathematics program used in the school districts. However, the Go Math! program group students achieved larger gains than the control group students who used another mathematics program. These greater gains were consistent across the grade levels. In addition, analysis of the Go Math! group student data clearly demonstrated that the program is effective with lower pretest achieving students and higher achieving students.