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A STUDY OF THE INSTRUCTIONAL EFFECTIVENESS OF *GO MATH! ©2014*

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ABSTRACT

To assess the instructional effectiveness of several instructional units of Houghton Mifflin Harcourt GO Math! ©2014 program, researchers from Educational Research Institute of America (ERIA) assessed student math achievement in grades 6, 7, and 8 in ten different classes over a four week period. A quasi-experimental, pretest/posttest design was employed to compare math performance among students using several units from the new Common Core State Standards GO Math! program.

The focus of the study was to determine how students would succeed with a new program focusing on the CCSS (Common Core State Standards). Of particular interest was whether the program could be successful with students from lower socio-economic backgrounds and also with students who scored lower on pretest assessments.

The assessments for each instructional unit used in this study were developed by researchers at ERIA; the reliability tests reported in the study indicate that the posttest had reasonable psychometric properties.

All participating teachers either volunteered to participate in the study or were asked to participate by school administrators. The results showed that the **Go Math!** classes made significant gains over the 4 week period. The effect sizes were large for the mathematics score increases for the total group of students at each grade level. The results also show consistent evidence at grades 6, 7, and 8 that the **Go Math!** lower pretest students made gains as great as, or greater than, their higher scoring colleagues. The analysis clearly showed that the **Go Math!** program was equally effective with both higher and lower pretest scoring students.

Overview of the Study

Since the passing of the No Child Left Behind legislation and the National Math Panel Report, the demand on schools to implement mathematics programs that are grounded in scientifically based research with proven efficacy has been more important than ever. Recent state initiatives and development of the Common Core Standards (CCSS) for Mathematics have put even greater emphasis on proven mathematics instruction to improve student achievement.

As students are expected to perform at greater levels under the Common Core, Houghton Mifflin Harcourt is in the process of updating and extending its very successful **GO MATH!** program to be sure it meets all of the standards listed in the Common Core State Standards for students at grades 6-8.

To that end, Houghton Mifflin Harcourt asked the Educational Research Institute of America (ERIA) to conduct a tryout efficacy study of the new **Go Math!** program to assure that students, especially those that are not high achieving students, will experience success with the program.

Design of the Study

The program's efficacy was evaluated using a pretest/posttest design. Before program instruction, ***Go Math!*** group students were administered a comprehensive test designed to cover the content of the units included in the study. These units were designed to support the Common Core State Standards (CCSS).

Additional data was collected from participating teachers to determine program use and teacher perceptions of the program. Upon completion of their participation in the study, the teachers completed a questionnaire that asked about their use of the program during the study.

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 middle grade level students in a school enrolling a large percentage of students enrolled in free/reduced lunch programs?
2. Is ***GO MATH!*** effective in improving the mathematics skills and problem solving strategies of lower performing as well as higher performing middle grade level students?

Study Participants

The study was conducted in a single middle school. The program effectiveness data reported here is based on a sample which included the following numbers of teachers and classes:

Grade 6	**Grade 7**	**Grade 8**
1 teacher	2 teachers	2 teachers
4 ***GO MATH!*** classes	2 **Go MATH!** Classes	4 **Go MATH!** Classes

In all, a total of 5 different teachers, and 10 different classes were included in the study sample.

Timeline and Program Use

All ***GO MATH!*** teachers used the program for approximately four weeks during the second semester of the school year. Pretests were administered by teachers at the end of March and posttests were administered at the beginning of May. This was the first time the teachers had used the program and most were unfamiliar with the program prior to the tryout.

Teacher surveys indicated that teachers used the program for 5 class periods per week and that most classes were 45 minutes or longer. Most of the teachers completed the program in less than the 4 week time allocated for instruction.

Teachers also reported that the less able students struggled with the program and that they expected that the program would be less successful with these students. This finding suggests that the new (CCSS) are going to be a challenge for many struggling students.

Description of the Research Sample

Table 1 provides the demographic characteristics of the school included in the study. Table 1 reveals that the school included in the study enrolled almost all students who were eligible for free or reduced lunch programs. The school is classified as a low socio-economic school. The tryout with these students sought to determine if generally low achieving students could increase their performance using the ***GO MATH!*** program based on the newly adopted Common Core State Standards.

Table 1
Demographic Characteristics
For the School Included in the Study

Location	Grades	Students Enrolled	% Students Free/Reduced Lunch	% Minority	% Special Education Needs
Mid-Size Central	6 to 8	723	99%	95%	14%

Description of the Assessments

The pretest and posttest used in the study were developed by mathematics assessment and curriculum specialists at the Educational Research Institute of America. The assessments were created to match the math instruction of the units and lessons to be covered during a 4 week period of the tryout.

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 Common Core State Standards (CCSS).

All 3 tests included 35 multiple-choice items. Table 2 provides the basic test statistics. The table shows that the reliabilities of the tests are adequate for determining instructional growth. It is important to note that the reliabilities increased from pretests to posttests at all 3 grades. The lower reliabilities on the pretests were the result of less knowledge and more guessing by students on the pretests than on the posttests.

Table 2
Pretest and Posttest Statistics for the *GO MATH!* and Control Students
Grades 6, 7, and 8

Test	Number of Items	Mean Standard Score	Standard Deviation	KR 20	SEM*
Grade 6 Pretest	35	285	46.5	.63	2.65
Grade 6 Posttest	35	315	48.9	.79	2.63
Grade 7 Pretest	35	282	45.9	.44	2.50
Grade 7 Posttest	35	318	47.7	.70	2.41
Grade 8 Pretest	35	282	43.2	.65	2.47
Grade 8 Posttest	35	318	49.7	.68	2.61

**SEM stands for Standard Error of Measurement and is based on raw score standard deviations.*

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 6, 7, and 8:

- A paired comparison *t*-test was used to compare the pretest mean standard scores with the posttest mean standard scores for all students at each grade.
- The students at each grade level were 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 paired *t*-test 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

Instructional Approach under Study

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

HMH GO Math! series was written specifically to support the Common Core State Standards for Mathematics with a focus on depth of instruction, equal emphasis on conceptual understanding and procedural fluency, the integration of the Standards for Mathematical Practice with every lesson, and a coherent articulation across grade levels. The HMH GO Math! series' organization emphasizes the Critical Areas of the Common Core Standards and depth of understanding through interactive lessons, research based instructional approaches, best practices, and differentiated instructional resources to ensure success for all students. With an emphasis on developing 21st century skills, the program includes comprehensive digital resources to support students, teachers, administrators, and parents. The authorship team for HMH GO Math! includes mathematics educators and district personnel who have been involved in Common Core State Standards for Mathematics implementation. The team's balance between research expertise and practical experience makes HMH GO Math! both accessible and mathematically sound.

HMH GO Math! also:

- *helps prepare students for PARCC and Smarter Balance Assessments through HMH's Personal Math Trainer, a digital assessment and intervention system that provides learning tools and real-time feedback to students, and reports on students' and classroom achievement to instructors.*
- *allows students to interactively explore new concepts through the Explore Activities, virtual manipulatives, Animated Math tutorials, video tutorials and Personal Math Trainer's scaffolded assessment support.*
- *reinforces teaching the Common Core Standards with Teacher Editions that provide Professional Learning with a focus on teaching for depth and strategies for incorporating the Mathematical Practices into every lesson, as well as Professional Development videos featuring author Juli Dixon modeling best practices in a classroom.*
- *delivers the next generation interactive digital student edition that works on all Internet-enabled devices, including tablets and smartphones, offers write-in functionality and note-taking capabilities, and contains point-of-use links to Math on the Spot Video Tutorials, Animated Math activities and simulations, and Personal Math Trainer online practice and help*

Since this was only a selected tryout of the program only specific units and lessons were included. Those units were selected by program editors and curriculum specialists. They were selected based on the probability the units represented materials that were typical of the difficulty level of the total program and that they were units that would most likely be used for instruction during the second semester of the school year.

Grade Six Data and Analyses

Total Group Analysis

For this analysis, researchers were able to match the pretest and posttest scores for 97 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 3 shows that the average standard score on the Total Mathematics pretest was 285 and the average standard score on the posttest was 315. The increase from pretest to posttest was statistically significant at the ≤.0001 level. The effect size was large.

Table 3
Grade 6 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 Pretest	97	285	46.5	9.064	≤.0001	.92
Total Mathematics Posttest	97	315	48.9			

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 mathematics standard scores. The group of 97 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 48 students in the lower scoring group and their average standard score on the pretest was 252, with scores ranging from 190 to 277. The higher scoring group included 49 students and their average standard score on the pretest was 317, with scores ranging from 277 to 488.

Pretest-to-posttest standard score comparisons are shown in Table 4 for the lower and higher pretest scoring students. 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.

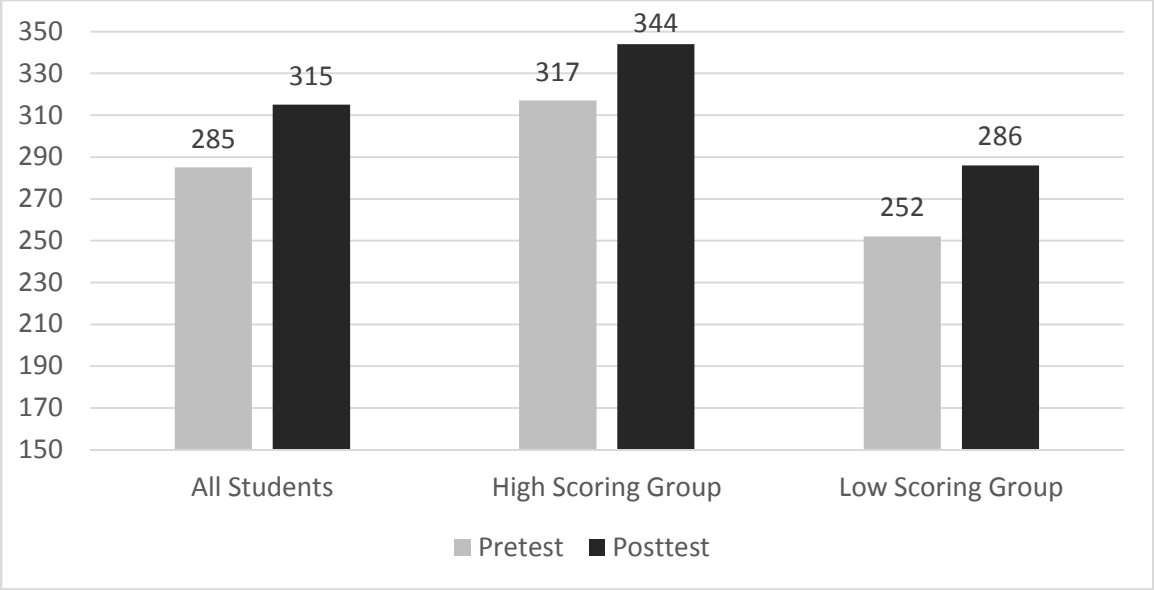
The pretest-to-posttest increases in average standard scores for both the lower and higher pretest group students were significant at the ≤.0001 level. The effect sizes for both the high scoring and low scoring pretest groups were large.

Table 4
Grade 6 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Students

Test	Test Form	Number Students	Mean	SD	t-test	Significance	Effect Size
Lower Scoring Group							
Total Mathematics	Pretest	48	252	19.9	6.432	≤.0001	1.24
Total Mathematics	Posttest	48	286	30.0			
Higher Scoring Group							
Total Mathematics	Pretest	49	317	41.9	6.479	≤.0001	.94
Total Mathematics	Posttest	49	344	46.6			

Figure 1 shows the pretest and posttest scores for the total grade 6 group of students as well as for the higher and lower pretest scoring groups. The largest standard score gain (34 points) was made by the low pretest scoring group. The standards score gain for the high pretest scoring group was 27 points, and the standard score gain for the total group was 30 points.

Figure 1
Comparison of Standard Score Gains
All Grade 6 Students, High Pretest Students, and Low Pretest Students



Grade Seven Data and Analyses

Total Group Analysis

For this analysis, researchers were able to match the pretest and posttest scores for 67 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 5 shows that the average standard score on the Total Mathematics pretest was 282 and the average standard score on the posttest was 318. The increase from pretest to posttest was statistically significant at the ≤.0001 level. The effect size was large.

Table 5
Grade 7 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 Pretest	67	282	45.9	6.675	≤.0001	.82
Total Mathematics Posttest	67	318	47.7			

High and Low Scoring Students

Another analysis was conducted 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 mathematics standard scores. The group of 67 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 33 students in the lower scoring group and their average standard score on the pretest was 246, with scores ranging from 188 to 288. The higher scoring group included 34 students and their average standard score on the pretest was 317, with scores ranging from 288 to 414.

Pretest-to-posttest standard score comparisons are shown in Table 6 for the lower and higher pretest scoring students. 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.

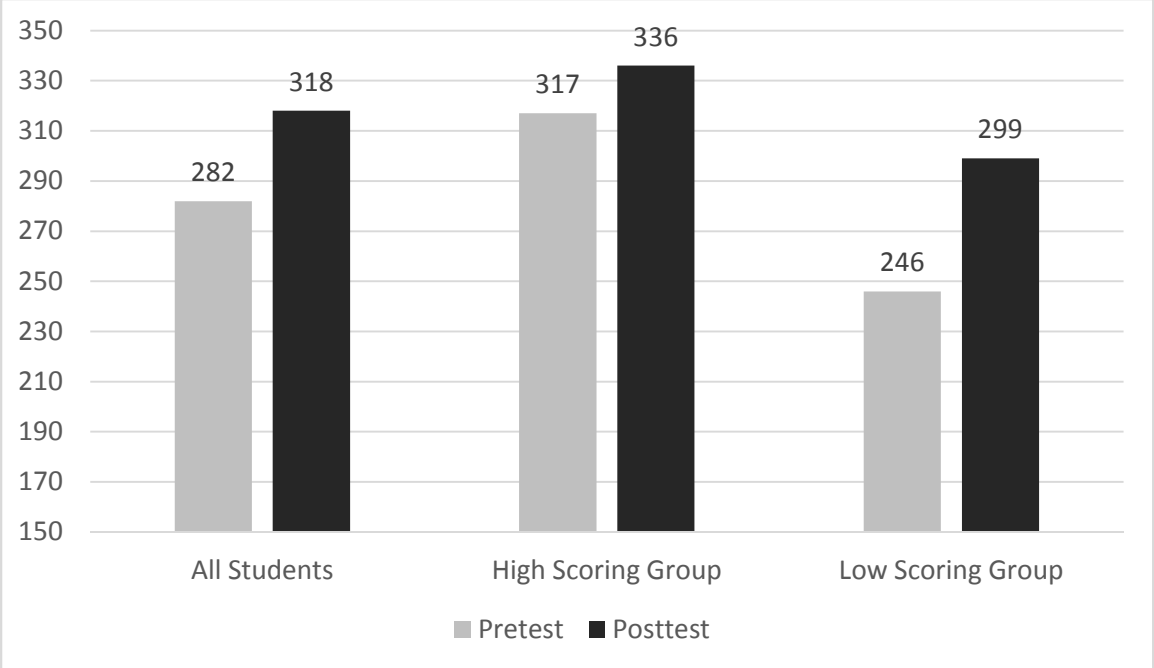
The pretest-to-posttest increase in average standard scores for lower pretest group students was significant at the ≤.0001 level and for the higher pretest scoring group the difference was also statistically significant (≤.001). The effect size for the high scoring group was medium while the effect size for the low scoring group was large.

Table 6
Grade 7 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Students

Test	Test Form	Number Students	Mean	SD	t-test	Significance	Effect Size
Lower Scoring Group							
Total Mathematics	Pretest	33	246	26.3	6.334	≤.0001	1.15
Total Mathematics	Posttest	33	299	43.6			
Higher Scoring Group							
Total Mathematics	Pretest	34	317	30.6	3.532	≤.001	.68
Total Mathematics	Posttest	34	336	45.1			

Figure 2 shows the pretest and posttest scores for the total grade 7 group of students as well as for the higher and lower pretest scoring groups. The largest standard score gain (53 points) was made by the low pretest scoring group. The standards score gain for the high pretest scoring group was 19 points, and the standard score gain for the total group was 36 points.

Figure 2
Comparison of Standard Score Gains
All Grade 7 Students, High Pretest Students, and Low Pretest Students



Grade Eight Data and Analyses

Total Group Analysis

For this analysis, researchers were able to match the pretest and posttest scores for 138 students. Students who did not take both the pretest and the posttest were not included in the analyses.

Table 7 shows that the average standard score on the Total Mathematics pretest was 282 and the average standard score on the posttest was 318. The increase from pretest to posttest was statistically significant at the ≤.0001 level. The effect size was large.

Table 7
Grade 8 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 Pretest	138	282	43.2	9.473	≤.0001	.82
Total Mathematics Posttest	138	318	49.7			

High and Low Scoring Students

Another analysis was conducted 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 138 students was divided into two groups. The first group included those students who scored lower on the pretest. There were 69 students in the lower scoring group and their average standard score on the pretest was 250, with scores ranging from 167 to 276. The higher scoring group also included 69 students and their average standard score on the pretest was 313, with scores ranging from 276 to 439.

Pretest-to-posttest standard score comparisons are shown in Table 8 for the lower and higher pretest scoring students. 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.

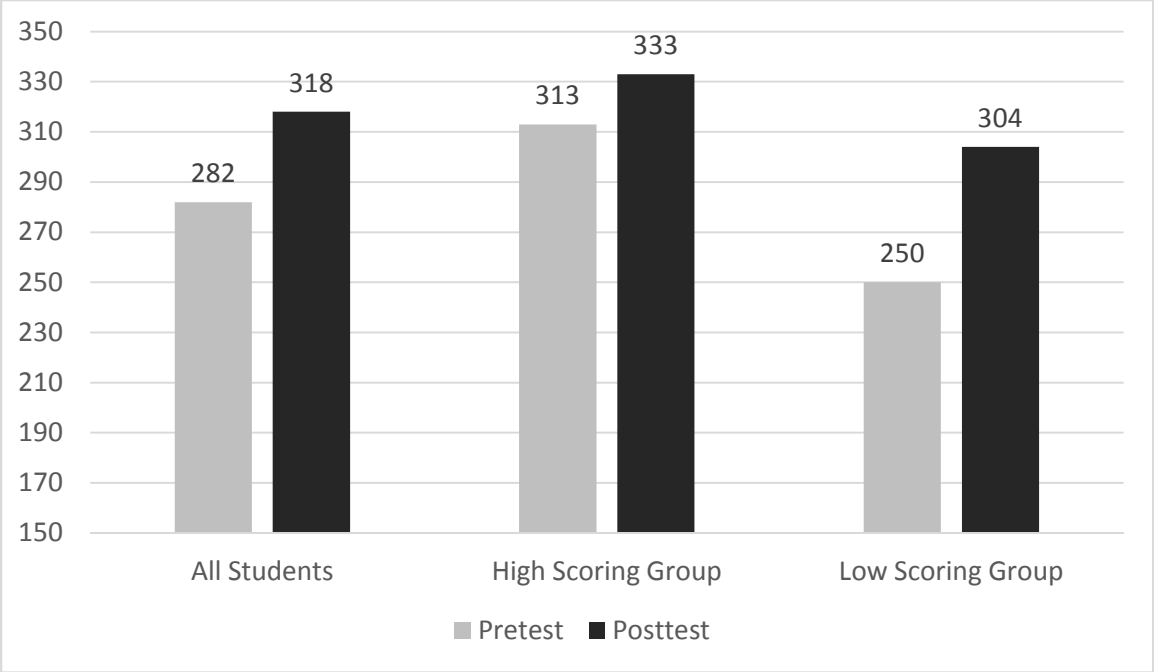
The pretest-to-posttest increases in average standard scores for both the lower and higher pretest group students were significant at the ≤.0001 level. The effect sizes for the high scoring group was medium while the effect size for the low scoring group was large.

Table 8
Grade 8 Paired Comparison *t*-test Results for Pretest/Posttest Standard Scores for the High- and Low-Scoring Pretest Students

Test	Test Form	Number Students	Mean	SD	t-test	Significance	Effect Size
Lower Scoring Group							
Total Mathematics	Pretest	69	250	22.1	10.143	≤.0001	1.32
Total Mathematics	Posttest	69	304	43.3			
Higher Scoring Group							
Total Mathematics	Pretest	69	313	36.0	4.037	≤.0001	.52
Total Mathematics	Posttest	69	333	51.7			

Figure 3 shows the pretest and posttest scores for the total grade 8 group of students as well as for the higher and lower pretest scoring groups. The largest standard score gain (54 points) was made by the low pretest scoring group. The standards score gain for the high pretest scoring group was 20 points, and the standard score gain for the total group was 36 points.

Figure 3
Comparison of Standard Score Gains
All Grade 8 Students, High Pretest Students, and Low Pretest Students



Conclusions

The increased student expectations of the Common Core State Standards demand that math programs are designed to ensure that all students can successfully master these more rigorous standards. Thus, this study sought to determine the effectiveness of the new Houghton Mifflin Harcourt ***GO MATH!*** with students who are enrolled in a relatively low socio-economic school.

Several units of the program were tried out with grade 6, 7, and 8 students who were enrolled in a school with a high percentage of free/reduced lunch program students, indicating a fairly low socio-economic level.

Two research questions guided the study:

1. Is ***GO MATH!*** effective in improving the mathematics skills and problem solving strategies of middle grade students in a school enrolling a large percentage of students enrolled in free/reduced lunch programs?

2. Is ***GO MATH!*** effective in improving the mathematics skills and problem solving strategies of lower performing as well as higher performing middle grade level students?

Question 1: Is GO MATH! an effective program at grades 6, 7 and 8?

A psychometrically sound mathematics test was used as the pretest and posttest instrument for ***GO MATH!*** students. Paired comparison statistical tests showed that at all three grades the ***GO MATH!*** classes increased their scores statistically significantly and the effect sizes were large.

Question 2: 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 the lower pretest scoring groups and large or medium for the higher scoring groups.

Perhaps the most important conclusion from the study is that middle grade students who had previously had no exposure to the more challenging materials that will be found in mathematics programs focused on the CCSS made statistically significant score increases in only a four week program. It will be interesting to note how students perform after they have been instructed with programs utilizing the CCSS standards from the lowest grades.

In conclusion, the results of this study indicate that the **GO MATH!** program leads to improved mathematics achievement. At all three grade levels, students using **GO MATH!** had significantly greater performance following instruction with the program. Moreover, the lower pretest scoring students made larger gains than the higher pretest scoring students and this was consistent at all three graded levels.