



▶▶▶ Efficacy Study

Academy of MATH

Evaluation of the Effectiveness of the
Academy of MATH with 9th Grade Students
at University High School,
Orange County Public Schools, FL

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Executive Summary

Since 2003, University High School in Orlando, FL, has been working with AutoSkill International to implement an effective reading intervention program for their at-risk students. After two years of successful results with reading, University High School began a math intervention program in the 2005-6 school year based on the Academy of MATH[®]. An intervention solution designed to supplement and reinforce key mathematical concepts introduced in the classroom, the Academy of MATH helps struggling students to build fluency in the foundation skills of math, enabling them to move on to master critical gateway subjects, such as Algebra I, that are highly predictive of high school completion.

The current study was undertaken to investigate the effectiveness of the Academy of MATH program with struggling high school students in the 9th grade at University High School. Students identified as candidates were assigned to either a test or control group to achieve a randomized control trial (RCT) study design.

Summary of Findings

- ▶ In comparison with the control group, 9th grade students training on the Academy of MATH demonstrated significantly greater gains on the Total, Concepts & Application, and Computation subtest components of the Stanford Diagnostic Mathematics Test (SDMT).
- ▶ Students training on the Academy of MATH demonstrated gains of 1.4 grade levels on the Computation component of the SDMT in comparison with control group, which achieved a gain of 0.8 grade level.
- ▶ Students training on the Academy of MATH achieved statistically significant average gains on the FCAT Math Developmental scale score of 86.4 points in comparison with 45.3 points for all other 9th grade students.
- ▶ The Academy of MATH test group achieved an average of 49.1 skills mastered at a rate of 2.0 subjects per week, and achieved 25 hours of focused time on task training, indicating a well-implemented intervention program.

Methodology

At the start of the fall term of the 2005-6 school year, students at University High School in the 9th grade, scoring at Level 2 or below on the math section of the Florida Comprehensive Assessment Test (FCAT), were identified as candidates for the Academy of MATH study. Students were randomly assigned to either a test or control group to achieve a randomized control trial study (RCT) design. The demographics of each group were compared to confirm their equivalence in terms of gender and age. To reduce the possibility of confounding variables, English for Speakers of Other Languages (ESOL) students were excluded from the study. A total of 165 students were assigned to one of two groups (Table 1), with 74 students assigned to the test group and 91 to the control group.

All students in the study completed the math placement test in the Academy of MATH program and the online version of the Stanford Diagnostic Mathematics Test (SDMT). Following the completion of these tests, students in the test group started training on the Academy of MATH program while students in the control group continued training with their classroom math curriculum. Students in the test group received training on the Academy of MATH for two 40-minute periods each week in addition to their regular math curriculum. For the three remaining scheduled math periods, the students received math instruction guided by feedback from the reports generated by the Academy of MATH. Both groups continued to work on their curriculum through to the end of April 2006. All students completed the SDMT post-test during the first week of May 2006.

Table 1: Study Group Assignment			
Grade	Control Group	Academy of MATH Test Group	Total
9	91	74	165

Table 1 – Students who scored at Level 1 and Level 2 on the FCAT math test were randomly assigned to either the Academy of MATH test group or the control group.

Student Demographics

Free or Reduced Price Lunch Status

Students' eligibility for free or reduced price lunch is typically used as a measure of socioeconomic status. In the study 42.5% of the students in the control group and 45.3 % of the students in the Academy of MATH test group were eligible for a free or reduced lunch. There were no statistically significant differences in the test and control group ($X^2 = 20$ $p > 0.5$; Table 2).

Table 2 : Free or Reduced Lunch Status			
Status	Control Group	Academy of MATH Test Group	Both Groups
Not eligible for free or reduced lunch	55	39	94
Eligible for a free or reduced lunch	36	35	71
Total	91	74	165

Table 2 – The Academy of MATH test and control groups were matched for eligibility for free or reduced lunch, at 42.5% and 45.3% respectively. These rates are somewhat higher than the overall student population at University High School, which has a free/reduced lunch eligibility of 36%.

Gender

Approximately 60% of the students in both groups were female (Table 3). There were no statistically significant differences in the distribution of the gender between the groups.

Table 3: Study Group and Gender			
	Control Group	Academy of MATH Test Group	Both Groups
Gender			
Female	53	43	96
Male	38	31	69
Total	91	74	165

Table 3 – Differences in gender between the test and control groups were not statistically significant.

Race

The race of students was obtained from student records. The distribution of race by student was roughly equal in both the control and Academy of MATH test groups (Table 4). The largest racial group identified in the sample were Hispanic students (42%) followed by Caucasian (30%) and Black (17%) students.

Table 4: Race by Training Group			
	Control Group	Academy of MATH Test Group	Both Groups
Asian	2	0	2
Black	19	12	31
Hispanic	32	38	70
Indian	1	0	1
Middle Eastern	3	3	6
Caucasian	29	21	50
Unknown	5	0	5
Total	91	74	165

Table 4 – The largest proportion of students in the study were Hispanic students at 42% and Caucasian students at 30%.

Training Achievement

The Academy of MATH provides measures of training achievement, which can be used to gauge the progress of the implementation. The measures are summarized in Table 5.

Time in Program

The Academy of MATH monitors the amount of time that students have been logged into the program. The Time in Program measure provides information on the amount of time students had access to the software.

Time on Task – Training Fidelity

The Time on Task metric provides a precise measurement of the amount of time that students were directly training on the program. This measure of training fidelity does not include periods of time where students were logged into the program but were not training.

Math Subjects Mastered

The Time on Task measure gives a good indication of the degree of directed work that students have devoted to training on the Academy of MATH. However, not all students are able to learn at the same rate. The Academy of MATH delivers the student training program as a series of modules or “subjects” that can be tailored to meet each student’s specific needs. When a student demonstrates a high level of proficiency in a specific subject it is deemed that the student has mastered that subject.

Rate of Skill Acquisition

Examining the rate at which students master subjects provides a good indication of the rate of progress students achieve while training. The measure of subjects mastered per hour of Time on Task is obtained by dividing the total number of subjects mastered by each student by the Time on Task they have achieved. Slower rates of progress usually indicate a higher level of difficulty with subjects. This is typical of students that are working on the more advanced skills presented towards the middle and end of the training sequence. Lower rates may also reflect students that are having a difficult time with the subject material.

Table 5: Academy of MATH Training Achievement				
	Time in Program	Time on Task	Subjects Mastered	Subjects Mastered per Hour of Time on Task Training
Average	42.1	25.4	49.1	2.0
Minimum	14.0	5.5	8	.8
Maximum	59.5	42.4	105	5.6
St. Dev.	6.9	6.4	19.6	.8

Table 5 – Students training on the Academy of MATH demonstrated a good rate of skill mastery, with an average of 49.1 subjects at a rate of 2.0 subjects per hour of focused time on task training.

Program Completion

When students start training on the Academy of MATH they are assigned an Individualized Training Program established through a placement test. The training program consists of a series of increasingly difficult math subjects that students work through at their own pace.

Students in the 9th grade completed, on average, 63% of the training program. At the end of the school year, 14% of the students had completed their entire training stream (Table 6).

Table 6: Percentage of Training Program Completed						
Student Grade	Number of Students	% Program Completed	Std. Deviation	Minimum	Maximum	% of Students Completing $\geq 90\%$ of Program
9	74	63%	20.1	9%	100%	14%

Table 6 – University High School 9th grade students demonstrated good progress on the Academy of MATH by the end of the study period in May 2006. On average, students completed 63% of their individualized training streams, while 14% of students completed the entire program.

Performance Measures

Stanford Diagnostic Mathematics Test

The Stanford Diagnostic Mathematics Test Fourth Edition (SDMT) is a widely recognized math test used to evaluate students' competence in basic math skills and concepts. Recently, the SDMT was adapted to an online format that facilitates consistency in test administration and scoring. Studies have shown the paper and pencil and online versions of the test provide comparable results (Paek, 2005, Wang 2004).

The SDMT provides feedback on the students' competence in the areas of Concepts and Application (subtest 1) and Computation (subtest 2). A "Total" test score is also provided. All test scores are presented in Grade Equivalent format. A summary view of gains of Academy of MATH test and control groups on SDMT components is illustrated in Figure 1.

Figure 1: Summary Change Scores on the SDMT

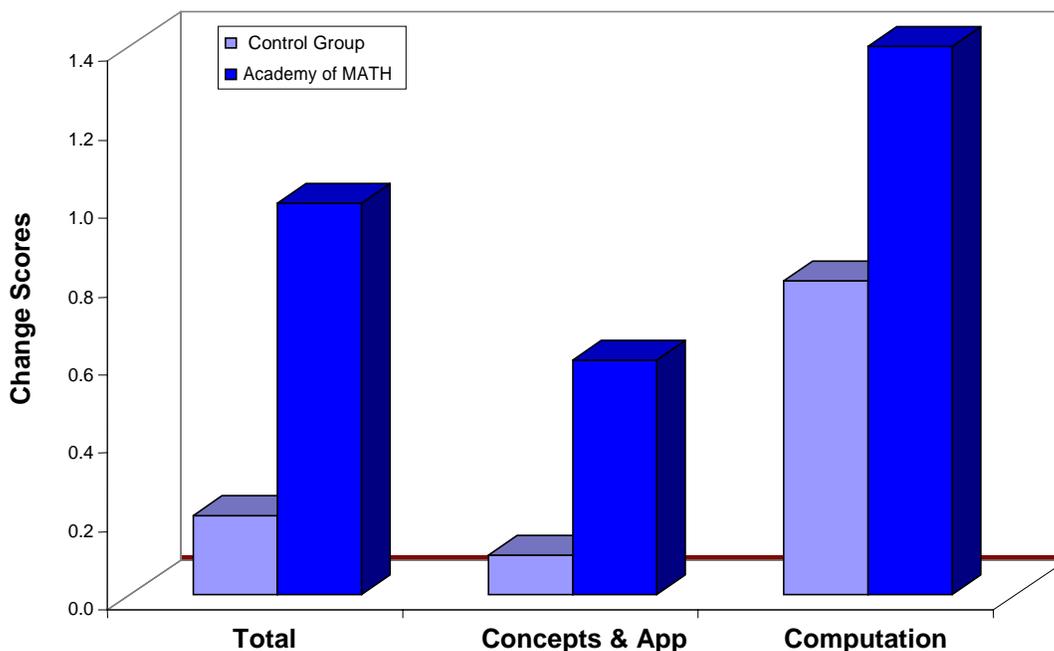


Figure 1 – The Academy of MATH test group demonstrated statistically significant gains greater than the control group in all three measures on the Stanford Diagnostic Mathematics Test (SDMT).

SDMT: Total Score

A total of 152 9th grade students completed both the pre- and post-training versions of the SDMT. Seventy-four students were in the Academy of MATH test group and 78 students were represented in the control group (Table 7). Data analysis using a two-way ANOVA revealed a statistically significant study group (test, control) by test group (pre-test, post-test) interaction ($F[1,150] = 6.8$ $p < .01$). Subsequent post-hoc analysis using a pair-wise student t-test demonstrated that the control group did not show a statistically significant change in post-test scores in comparison with their pre-test scores ($t [77] = 0.81$ $p > 0.5$). In contrast, students

in the group receiving training on the Academy of MATH program demonstrated statistically significant gains of 1.0 grade level ($t [73] = 4.4$ $p < .001$; Table 7).

Table 7: 9th Grade SDMT Results				
Total Score - Grade Equivalent Score				
	Number of Students	Pre-test Score	Post-test Score	Change
Control Group	78	6.7	6.9	0.2
Academy of MATH Group	74	7.0	8.0	1.0*
* Statistically significant increase in post-test score $p < .001$				

Table 7 – Students training on the Academy of MATH demonstrated significant gains on the post-training test scores of 1.0 grade level in comparison with the control group's non-significant gains of 0.2 level.

SDMT: Math Concepts and Application

Data analysis of the Math Concepts and Application subtest data using a two-way ANOVA did not demonstrate a statistically significant effect of study group (test, control) by test group (pre-test, post-test) interaction ($F[1,147] = 2.4$ $p \leq .12$). However, subsequent post-hoc analysis using pair-wise student t-test demonstrated that the control group did not demonstrate a statistically significant change in post-test scores in comparison with their pre-test scores ($t [75] = 0.4$ $p = > .05$). In contrast, students in the test group receiving training on the Academy of MATH program demonstrated statistically significant gains of 0.6 grade level ($t [72] = 2.3$ $p < .02$; Table 8).

Table 8: 9th Grade SDMT				
Results Subtest 1 - Math Concepts and Application				
	Number of Students	Pre-test Score	Post-test Score	Change
Control Group	76	7.4	7.4	0.1
Academy of MATH Test Group	73	7.3	8.0	0.6*
*Statistically significant increase in post-test score $p \leq .02$				

Table 8 – Students training on the Academy of MATH demonstrated statistically significant gains on the post-test scores of 0.6 grade level in comparison with the control group that demonstrated non-significant gains of 0.1 level.

SDMT: Computation

Data analysis of the Math Computation subtest data using a two-way ANOVA did not demonstrate a statistically significant effect of study group (test, control) by test group (pre-test, post-test) interaction ($F[1,136] = 1.30$ $p > .05$). However, a main effect of the test group was observed ($F[1,136] = 14.9$ $p < .001$). Students in the Academy of MATH test group demonstrated high scores on both the SDMT pre- and post-tests in comparison with the control groups. Both groups demonstrated statistically significant gains in their computation scores at post-testing, with the Academy of MATH group achieving the highest gains of 1.4 grade levels versus a 0.8 gain by the control group (Table 9).

Table 9: 9th Grade SDMT Results Sub test 2 – Computation				
	Number of Students	Pre-test Score	Post-test Score	Change
Control Group	71	6.2	6.9	.8*
Academy of MATH Test Group	67	7.5	8.9	1.4*
*Statistically significant increase in post-test score $p < .001$				

Table 9 –Students receiving training on the Academy of MATH demonstrated statistically significant gains of 1.4 grade levels on the computation subtest in comparison with the control group, which demonstrated a 0.8 gain.

FCAT – Developmental Level Scale Scores

FCAT – 9th Grade

Previous year and current year FCAT data were also available for most students participating in the study. Students' previous year and current math developmental level scale scores were compared. An ANOVA analysis revealed a statistically significant main effect of year of testing ($F[1,157] = 99.0$ $p < .001$; Table 10) with no statistically significant differences between groups or a significant interaction. This indicates that students' scores in both groups increased from one year to the next.

The average increase in FCAT scores was 25.5 points higher in the group receiving training on the Academy of MATH program in comparison with the control group.

Table 10: 9th Grade FCAT Results				
Developmental Achievement Level Scale Scores				
	Number of Students	Pre-test Score	Post-test Score	Change
Control Group	85	1799	1860	60.9
Academy of MATH Test Group	74	1786	1872	86.4

Table 10 – Students in the Academy of MATH test group scored an average change of 86.4 points on the FCAT, compared to 60.9 points for the control group.

FCAT Score Analysis

FCAT math development scale scores were available for all 9th grade students at University High School. The overall average year over year change in math scores for all 9th grade students was 45.3. This score is slightly lower than the gains achieved by the control group and is statistically significantly lower than the 86.4 point gain demonstrated by the students training on the Academy of MATH ($F[1,894]=10.5$ $p \leq .001$; Figure 2).

Figure 2: Comparison of Gains in FCAT Scores

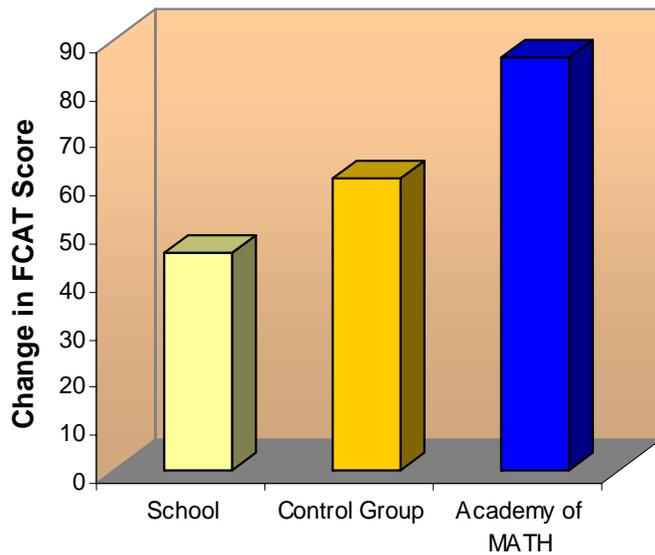


Figure 2 – The Academy of MATH test group scored a statistically significant FCAT score change of 86.4 vs. the entire 9th grade school population, which achieved a change of 45.3.

Discussion

Beginning in August 2005, 9th grade students at University High School began a year-long study to determine the efficacy of the Academy of MATH for high school math remediation. Students were chosen based on their performance in the past year's FCAT math test (Level 1 and Level 2), and were assigned to either a test or control group in a randomized control trial (RCT) study design.

After training for eight months in the Academy of MATH and gaining an average of 25 hours of focused time on task training, the test group showed a clear and significant improvement in their foundation math skills. Scores on the SDMT Computation subtest, which tests specifically for foundation skills, showed that the Academy of MATH test group scored a 1.4 grade level gain, while the control group increased only 0.8 grade level.

Analysis of the FCAT data from 2006 shows the Academy of MATH test group achieved a gain of 25.5 points on average over the control group – and posted a 41 point gain over the overall 9th grade population. These data points demonstrate an early, positive impact on math achievement for the test group. Follow-up analysis of 2006-2007 data is necessary to document the long-term impact that building fluency in the foundation skills of math will have on this cohort of at-risk students.

Results from an AutoSkill attitude survey will measure changes in motivation and attitude among the test group students. That data will be made available in fall 2006.

References

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About AutoSkill

AutoSkill International Inc. delivers highly effective and scalable reading and math intervention solutions to help struggling elementary, middle and high school students develop fluency in the foundation skills of reading and math. AutoSkill products use a research-based approach that is proven to generate significant and sustainable gains for at-risk students of all ages and abilities. The company's award-winning software provides an individualized and engaging experience for students, and comprehensive set of monitoring, management and reporting tools for teachers and administrators. AutoSkill deploys its reading and math intervention solutions across schools and districts in North America and Europe.

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