DIFFERENTIATING MATH INSTRUCTION

A LARGE-SCALE STUDY OF ACCELERATED MATH: FINAL REPORT

How educators can meet and manage increasingly diverse math needs of students.

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How Educators Can Meet and Manage Increasingly Diverse Math Needs of Students.

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ABSTRACT *This is a final report of a large experimental study which explores how a curriculum-based instructional management system, Accelerated Math, supports differentiated instruction and helps educators meet the wide-ranging learning needs of their increasingly diverse classrooms. It examines the math achievement and attitudes of a nationwide sample of 2,202 students in grades 3–10 during spring semester 2002. It compares classrooms in 24 states that used Accelerated Math to same-school control classrooms that did not use it. Among the major findings are:*

- *Students in Accelerated Math classrooms experienced exceptional gains in math compared to students in control classrooms. The difference in the gains in one semester ranged from 7 percentile points in grade six to 14 percentile points in grades three and five.*
- *Gains were experienced across the achievement spectrum. An analysis of low-, middle-, and high-achieving students showed consistently strong rates of gain for each math objective mastered.*
- *The gain for students with a high level of implementation averaged 18 percentile points, which is about nine times the gain of the control students.*
- *Teachers of Accelerated Math classrooms spend more time providing individual versus group instruction and feel better able to meet the individual needs of their students.*
- *Significantly more students who participated in Accelerated Math reported that they like math, help each other with math, and like math better this year than last year.*
- *Implementation of Accelerated Math results in improved performance for students at multiple points on the ability/disability spectrum. Accelerated Math had a significant effect in all respects for students who are gifted and talented, low achieving, English language learners, eligible for free or reduced lunch, and Title I.*

Based on the findings, the report concludes:

"The strong positive gains evidenced in this study were achieved by implementing Accelerated Math for only one semester, and putting the intervention in place in mid-year. The results were very impressive given the timing and length of time of the study. Accelerated Math is a powerful intervention for improving math outcomes for students."

Overview

School personnel face the difficult task of meeting the needs of an increasingly academically diverse population of students, especially in urban environments. There is a well-confirmed knowledge base on effective instruction, but teachers need massive amounts of information for effective, sustainable improvement and data-driven decision making. A major bottleneck to improving teaching and learning is lack of systematic, usable information on individual student performance and progress at the classroom level. This is especially true in teaching math in elementary, middle, and high school environments.

As school districts continue to focus on improving overall achievement of their students, particularly in math, there is a need to find ways to implement evidence-based principles of effective instruction. As educators investigate instructional correlates of positive educational outcomes, the same core factors emerge. These critical factors include: reinforcement, feedback, monitoring of student performance and understanding, cooperative learning, personalized instruction, and adaptive instruction. Two especially critical factors are differentiated instruction (matching the level of instruction to the level of skill development of the learner) and academic engaged time. In this study we investigated the effect of implementing a curriculum-based instructional management system, Accelerated Math, on improving educational outcomes for students in grades 3–10.

Accelerated Math math management software was used as an enhancement to the math curriculum and instruction program in the schools that participated in this study. It was selected because it is designed to assist teachers in implementing the following evidence-based principles: increased time to practice essential skills, at an appropriate level, with direct and immediate feedback to teachers and learners, personalized goal setting, use of technology to process store and report information, and universal success.

The Study

Accelerated Math is a task-level learning information system that was developed by Renaissance Learning, Inc. It is intended to accelerate the learning of mathematics when used in conjunction with the existing instructional practices and textbook already in place in the classroom. Accelerated Math was designed to:

- keep track of individual students' daily activities (prints and scores personalized practice assignments and tests for each student),
- provide immediate feedback to students and teachers through information generated from individual or class diagnostic reports,
- alert teachers when students are having difficulty with certain math objectives, and
- monitor student achievement.

Accelerated Math helps both teachers and students ensure that students are working at an appropriate level, mastering new objectives, and reviewing skills they have already mastered. With the information provided by Accelerated Math, teachers have the opportunity to make informed instructional decisions and tailor math interventions to meet the needs of individual students.

Several independent researchers have demonstrated positive effects of Accelerated Math on student math performance. In a study by Spicuzza and Ysseldyke (1999) the effects of this curriculum-based instructional management system on student math performance were examined during a six-week summer school program in an urban district. Results indicated that students using Accelerated Math showed an average gain of 5.75 NCE units on the Northwest Achievement Levels Test (NALT), a district math achievement test. In a more expansive study by Spicuzza, Ysseldyke, Lemkuil, Kosciolek, Boys, and Teelucksingh (2001) the effects of Accelerated Math on math achievement and classroom features known to be related to student achievement outcomes were found to be significant across high-, middle-, and low-performing students.

Ysseldyke, Spicuzza, Kosciolek, Teelucksingh, Boys, and Lemkuil (2003) found that students enrolled in classrooms where Accelerated Math was used as an enhancement to the curriculum consistently outperformed students enrolled in classrooms using only the Everyday Math (SRA/McGraw Hill, 1988) curriculum. Furthermore, these authors report that (1) gains in math performance were consistent for high-, middle-, and low-performing students, and (2) gains were greatest when teachers implemented the program to a greater degree and with the highest fidelity of treatment. Finally, Teelucksingh, Ysseldyke, Spicuzza and Ginsburg-Block (2001) studied the effects of consultation procedures used together with the Accelerated Math curriculum-based instructional management system on the performance of English language learners. They found significantly positive outcomes for the program.

In addition, many schools across the U.S. have implemented Accelerated Math with success. For example:

Michigan Avenue Elementary School in Cleveland, Tenn., a rural, Title I school with 58 percent of its K–5 students qualifying for free or reduced lunch, implemented Accelerated Math during the 1998–1999 school year. Implementation of Accelerated Math resulted in STAR Math computer-adaptive math test and database score gains of 32 percentile points and 2 grade equivalents for 237 students in grades three through five. (Renaissance Learning, 2000).

In a three-and-a-half month study of 103 high school students in Buhler, Kan., students using Accelerated Math experienced more improvement than students in control classes using the same textbooks with traditional instruction. Stanford Achievement Test 9 average test score gain across all subjects (pre-algebra, algebra, and geometry) for the 50 students using Accelerated Math was 12 percentile points compared to a gain of 3.8 percentile points for the 53 control students who did not use Accelerated Math. Students also responded to attitudinal surveys at the beginning and end of the study; at the end, students using Accelerated Math showed more improvement in attitudes toward math than students in the control classes (Gaeddert, 2001).

Purpose

The purpose of this study was to investigate the effects of using Accelerated Math in elementary, middle school, and secondary school settings. We were interested in the extent to which students in Accelerated Math classrooms profited in comparison to matched control groups of students in their same grades and schools. Secondary research questions concerned the extent to which results differed as a function of intervention integrity (or fidelity of treatment) and teacher use of supplemental implementation assistance. Questions about the effects of using Accelerated Math with various demographic and achievement subgroups were also of interest. We asked the following research questions:

1. To what extent are there differences in gains in performance on math tests for students who participate in Accelerated Math instruction versus a control group of students in their same school and grade?
2. By grade, what are the average numbers of practice problems students attempted, their average percent correct on practice problems, the average number of test problems attempted, the percentage of test problems correct, the average number of objectives they master, and the number of objectives they master in the major library the students used?
3. To what extent is student performance a function of (or related to) the teacher's level of implementing the intervention?
4. How does student performance vary as a function of the extent to which the teacher uses supplemental implementation assistance services provided by the publisher of Accelerated Math?
5. What do teachers report about their math teaching practices, experiences using Accelerated Math, and satisfaction with the program?
6. What do students report about their experiences using Accelerated Math, their success with it, and changes in their attitude toward and performance in math?
7. To what extent is there variability among teachers in implementation of Accelerated Math, what does the variability look like, and how are specific variations in implementation related to student results?

8. To what extent are there difference in gains in performance on math tests for students who are gifted and talented, learning disabled or receiving special ed, low achieving, English language learners or receiving free or reduced versus control students and other students using Accelerated Math?

This report is the final report on these data. In it we provide information on the effects of implementing Accelerated Math on student performance in math. We also include information on the extent to which the performance is a function of intervention integrity. Results of analyses of subgroup performance are also reported. Due to the small sample sizes for higher grades, the analyses presented here for grades 7 through 10 should be evaluated with caution.

Methods

This study was conducted in 125 classrooms (67 experimental and 58 comparison) in 47 schools in 24 states (Ala., Ark., Calif., Ga., Idaho, Ill., Ind., Iowa, Kan., Mass., Mich., Minn., Mo., Mont., N.M., Ohio, Okla., Ore., Penn., Tenn., Texas, Va., Wash., Wis.) during spring semester 2002, January to May. A total of 2,397 students (1,319 experimental and 1,078 comparison) were assigned to participate in the study. Our sample was divided into experimental and comparison groups at each grade level 3 through 10. Five of the 2,397 students were second graders, so we eliminated them from the data analysis. We also found that the Accelerated Math program was not implemented with 187 of the students in the experimental classrooms. We eliminated from the study students who did not actually participate in the study, as indicated by the fact that they did not attempt any practice problems or test items. We also eliminated from the study students for whom a pre- or post-test score was not reported (two experimental and two control students were eliminated for this reason.) The final number of students on whom this study is based was 2,202. Demographic characteristics of those students are listed in Table 1. Both the experimental and control groups were comparable on major demographic variables.

Table 1: Demographic Information

Race	Gender	Grades												Totals		
		3		4		5		6		7 and 8		9 and 10				
Classroom Condition*		C	AM	C	AM	C	AM	C	AM	C	AM	C	AM	C	AM	All
Asian	Males		1					1						1	1	2
	Females	1	1											1	1	2
African-American	Males	6	3	2	9	4	4		1					12	17	29
	Females	6	4	5	5	7	3		1		1			18	14	32
Hispanic	Males	20	12	1				6	9					27	21	48
	Females	11	7	3	5	2		16	10					32	22	54
	Unspec.								2					0	2	2
Native American	Males		1											0	1	1
	Females	1	2		2				1					1	5	6
White	Males	46	45	26	35	39	37	33	25	23	21		1	167	164	331
	Females	49	46	21	22	40	27	27	19	33	25			170	139	309
	Unspec.	1	1			1		1						3	1	4
Not Specified	Males	45	34	111	111	79	121	27	37	14	9	8	10	284	322	606
	Females	44	25	118	99	70	111	35	48	11	9	11	14	289	306	595
	Unspec.	16	49	24	15	13	32	11	16	2	1	1	1	67	114	181
Totals		246	231	311	303	255	335	157	169	83	66	20	26	1072	1130	2202
		477		614		590		326		149		46				

*C = Control classroom; AM = Accelerated Math classroom

Teachers in the experimental group were asked to attend a one-day training seminar conducted by Renaissance Learning personnel prior to the start of the study. The training was designed to familiarize teachers with the functionality of Accelerated Math and provide guidelines for its integration into the teachers' curriculum and instruction. Sixty-six out of 68 experimental teachers attended this training.

All students in the experimental and control group classrooms were pretested using STAR Math. Individual students were assigned to Accelerated Math libraries of instructional objectives and activities that were appropriate based on their performance on STAR Math. Students were post-tested using STAR Math during May of the same school year.

Teachers in the experimental group were asked to fax Accelerated Math reports bi-weekly to Renaissance Learning. Upon receipt of the reports, Renaissance consultants analyzed them for evidence of implementation integrity. The consultants followed up the analysis with phone consultations with the participating teachers to assist with implementation. The degree to which teachers in the experimental group took advantage of this consultative support varied.

Data were collected on demographic variables, student performance during implementation of the program (e.g., number of practice problems attempted, percent of test items correct, numbers of objectives mastered), teacher use of Renaissance consulting services (e.g., numbers of diagnostic reports sent in), and student results.

Students are not always randomly assigned to classes and there may be pretest differences between groups. We ran a t-test on pretest normal curve equivalent (NCE) scores for experimental and control groups; they were not significantly different—mean difference=0.35; t=.445; p=.656. Results for pretest scaled score (SS) were similar and also not significant. We conducted an Analysis of Covariance to evaluate the extent to which students profited from participation in the program. The dependent variable was post-test performance (NCE or percentile) and the covariate was pretest performance.

We investigated the effects of intervention integrity by multiple methods, including dividing students into quartiles based on the numbers of practice problems they attempted. Then we compared the math gains for students in the top quartile with those in the bottom quartile. We used number of practice problems attempted as an indicator of intervention integrity because it correlated in excess of .90 with test problems attempted, percent of practice problems correct, and percent of test items correct. Other measures of intervention integrity involved regression analysis on post-test NCE scores using average percent correct on Accelerated Math tests and number of objectives mastered as a predictor, and an analysis of the use of supplemental implementation assistance.

At the conclusion of the study we administered a survey to both teachers and students asking about their experiences with the program, with mathematics instruction in general, and about their satisfaction with Accelerated Math. We asked teachers a set of questions about contextual factors (i.e., the curriculum used in their classroom, their grouping practices, time allocated to instruction in mathematics).

We followed up the main study by conducting a set of supplemental analyses on specific subgroups. In the original data collection, teachers were asked to identify subgroup membership (e.g., Title I) for their students. They seldom did so. Therefore, we contacted the schools and asked for more detailed demographic information on students, specifically for subgroup identifiers. In this subgroup analysis we report on the performance of students

who are gifted and talented, learning disabled or special education, low achievers, English language learners, Title I, or eligible for free or reduced lunch.

Results

Due to several factors, this report will focus predominantly on the analysis of findings for grades three through six. While results for grades 7 through 10 are reported, the sample size was small and findings of significance are difficult to ascertain. There is also some question as to whether STAR Math, intended to be a measure of general math ability, is an appropriate measure for the content typically covered in the higher grades.

Gains in Math Performance

All of our analyses were conducted separately for grades three, four, five, and six. We grouped the data for grades 7/8 and 9/10 in conducting our analyses because of the limited sample size at those levels. Means and standard deviations for the experimental and control groups on pre- and post-test STAR Math results are shown on Table 2. Data are disaggregated by grade level and the changes in both scaled score (SS) and normal curve equivalents (NCE) are shown. T-tests were used to examine the equality of mean SS and NCE scores at each grade level. These results are also shown in Table 2.

With the exception of grades 9 and 10, there were significant gains for both the experimental and control groups from pretest to post-test as measured by STAR Math scaled score. This was not always the case for control students when the unit of analysis was STAR Math NCE score. These findings simply tell us that over a single semester of math instruction, student performance tended to improve. The more important statistic is reflected in the t-test results in which we compared gain for the experimental versus control groups. At grades three, four, and five, students who participated in Accelerated Math gained significantly more (p<.001) than control students in their same schools. This finding was true for both SS results and for NCE. At sixth grade the difference in performance was still significant, though at the .05 level for SS and .03 for NCE. At grades 7/8 and 9/10 while there were positive gains, they were not statistically significant for the experimental and control groups.

At grades three through six, students who participated in the Accelerated Math program gained significantly more than those who did not. In fact, the differences were huge. Findings at grades 7/8 and 9/10 still favored those in the experimental group, though again not statistically significant.

Table 2: Experimental vs. Control Classrooms Results

		3		4		5		6		7 and 8		9 and 10	
		AM	C	AM	C	AM	C	AM	C	AM	C	AM	C
N		231	246	303	311	335	255	169	157	66	83	26	20
Average Days between Pre/Post		143	135	147	135	139	147	140	139	110	117	115	119
Pre SS	Mean	560.01	549.65	626.24	627.93	685.55	691.78	715.76	723.72	749.38	768.25	812.77	800.65
	Std. Dev.	84.29	74.68	81.77	88.28	65.92	73.98	85.59	95.87	64.65	77.74	54.22	53.99
Post SS	Mean	637.55	588.76	684.82	665.22	737.53	714.67	765.47	762.8	782.27	786.47	838.46	765.6
	Std. Dev.	82.9	83.24	85.74	85.46	87.38	80.04	114.49	93.82	87.53	83.33	81.23	133.02
SS Gain	Mean	77.53*	39.11*	58.57*	37.29*	51.98*	22.9*	49.71*	33.62*	32.89*	18.22**	25.69	-35.05
	Std. Dev.	78.01	66.25	67.3	61.51	67.47	60.66	76.1	98.87	66.67	63.13	81.59	128.36
AM Gain vs. Control Gain	*t*	5.80		4.09		5.42		1.97		1.38		1.96	
	p	<.001		<.001		<.001		.050		.171		.057	
Pre NCE	Mean	53.91	51.36	55.48	55.49	52.57	54.4	48.51	50.7	44.78	48.56	47.45	44.44
	Std. Dev.	19.84	17.88	19.15	20.3	16.64	17.77	19.01	18.51	14.7	16.4	10.91	11.11
Post NCE	Mean	64.66	54.41	62.45	57.32	59.57	53.83	54.52	52.99	49.86	50.12	51.33	38.82
	Std. Dev.	21.26	20.41	21.13	21.09	21.6	18.99	24.05	19.66	18.76	17.24	17.02	22.7
NCE Gain	Mean	10.75	1.06	6.97*	1.83**	7.01*	-0.57	6.00*	2.3	5.07**	1.56	3.88	-5.62
	Std. Dev.	17.91	16.43	16.22	15.09	16.29	14.52	16.2	15.1	13.73	12.82	16.31	21.82
AM Gain vs. Control Gain	*t*	6.16		4.06		5.87		2.12		1.61		1.69	
	p	<.001		<.001		<.001		.035		.110		.098	

* Gain significant at the $p<.001$ level. ** Gain significant at the $p<.05$ level.

We conducted an Analysis of Covariance comparing the post-test NCE scores earned on STAR Math by students in the experimental group to the scores earned by students in the control groups. We used pretest NCE scores as a covariate to control for non-random assignment of students to classrooms and treatment conditions. Again, those third-, fourth-, fifth- and sixth- graders who participated in the Accelerated Math program significantly outperformed those who did not participate in the program ($p< .001$ at grades 3, 4, 5, and $< .05$ at sixth grade). Again, differences were not statistically significant at grades 7/8 and 9/10.

We examined gains in percentile points from STAR Math pretest to STAR Math post-test for the students who did and did not participate in the Accelerated Math program. And, we examined gains in grade equivalents for the participants and the control groups. Results are shown in Table 3. At every grade there were large differences in grade equivalent score and percentile point gains for students in the experimental and control groups. Students who participated in the Accelerated Math program gained about 1 to 1.5 grade equivalents in the five months of intervention. Those in the control group gained about 0.5 grade equivalent in the five months of intervention. At grade six, the control group gained one year and at grades 9/10 the control group actually lost ground over the five months.

As expected, findings were similar for percentile changes. There were very significant differences at grades three and five; moderate differences in grades four, six, and 7/8; and, again, significant differences at grades 9/10. Students who participated in the Accelerated Math program significantly improved their performance on STAR Math.

The results of these analyses are especially impressive given that this program was a new implementation put in place in the middle of a school year and implemented for only one semester.

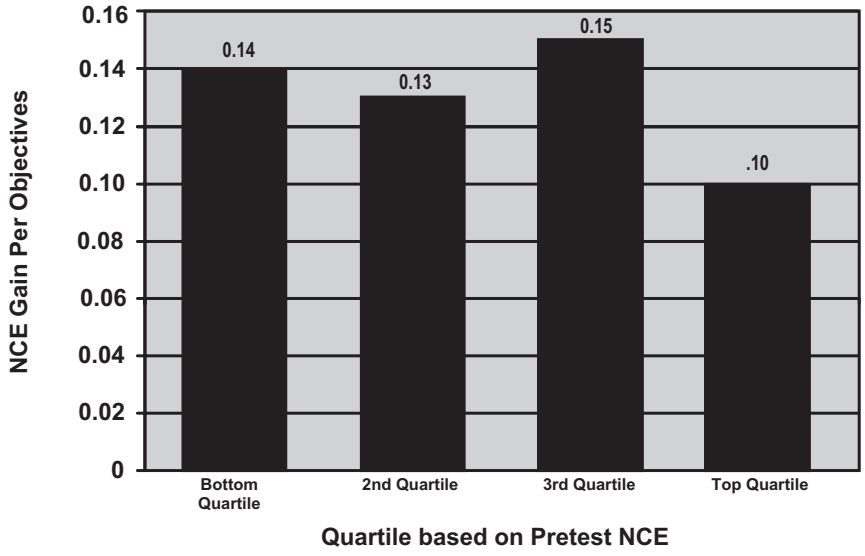
Table 3: Gain in Grade Equivalent and Percentiles by Grade and Classroom Condition

	3		4		5		6		7 and 8		9 and 10	
	AM	C	AM	C	AM	C	AM	C	AM	C	AM	C
Gain GE	1.0	0.4	1.0	0.6	1.2	0.5	1.4	1.1	1.1	0.6	1.4	-1.4
Difference in Gain	.6		.4		.7		.3		.5		2.8	
Percentile Gain	19	5	12	4	13	-1	12	5	10	3	8	-10
Difference in Gain	14		8		14		7		7		18	

One aspect we were particularly interested in was how well Accelerated Math works with low-, average-, and high-achieving groups. Because it supports differentiated instruction, one would expect that Accelerated Math would work well with all achievement groups. To analyze this, we did a regression analysis to estimate the rate of improvement per objective mastered by pretest NCE quartile. For the regression equation, the dependent variable was post-test NCE and the independent variables were pretest NCE and objectives mastered. The regression coefficient for objectives mastered therefore is an estimate of NCE gain per objective.

Figure 1 shows the results of this analysis. The NCE improvement per objective for all four achievement groups is quite good, ranging between .10 and .15 NCE per objective. All four coefficients were statistically significant at $p<.001$. Very encouraging is the fact that the bottom quartile students had the second highest rate of .14 NCE per objective, indicating the program works exceptionally well for this group.

Figure 1: NCE Gain Per Objective Mastered for Students



Subgroup Analyses Results

In keeping with the results reported previously, all supplemental analyses focus on students in grades three through six. However, instead of keeping the scope broad and looking at all students in each grade, the subgroup analyses narrow the focus to several smaller groups of students based on various demographic and socio-economic groupings. Because these groupings contain a smaller number of students overall, grade-level analysis is not reported.

Reporting of demographic and socio-economic information varied greatly across the sample of schools contributing data. Some schools did not submit demographic and socio-economic data initially, but did so when asked on follow-up. Other schools were unable to comply with requests for data due to district restrictions on the release of sensitive student information. Therefore, the sample of students with valid demographic, achievement, and socio-economic information is smaller than the total set of students. Only data for those classes where teachers included demographic information and socio-economic characteristics are included in these analyses.

All analyses in this supplemental report were conducted separately for each demographic or socio-economic group. The groups included in this report are students indicated as:

- Gifted and talented (G&T);
- Learning disabled and/or participating in special education (LD);
- Low achievers (having pretest scores below the 25th percentile);
- English language learners (ELL);
- Receiving free or reduced lunch (FRL); and
- Title I.

Gains in Math Performance

Means and standard deviations for the experimental and control students in each of the above groups on pre- and post-test STAR Math results are shown in Table 4. Both scaled score (SS) and normal curve equivalents (NCE) are shown. T-tests were used to examine the significance of the gain for each group and the equality of mean SS and NCE gains between the control and Accelerated Math groups.

Table 4: Experimental vs. Control Pre/Post Results for Students in Various Groups

		Gifted and Talented		Learning Disabled and/or Special Education		Low Achievers		English Language Learners		Free or Reduced Price Lunch		Title 1	
Condition		AM	C	AM	C	AM	C	AM	C	AM	C	AM	C
N		49	52	59	35	84	111	25	25	157	175	132	138
Average Days Between Pre/Post		139	137	148	133	151	140	140	126	152	138	147	142
Pre SS	Mean	696.7	703.1	570.3	575.8	520.3	530.9	592	604.2	607.2	620.8	606.3	594.2
	Std. Dev.	82.3	81.0	89.4	144.9	64.0	79.4	90.6	73.7	105.3	108	105.2	100.5
Post SS	Mean	757.3	749.5	622.6	651.9	614.2	588.9	664.6	623.6	662.1	654.5	669.7	634.2
	Std. Dev.	121.1	66.0	103.1	119.2	81.9	82.8	73.7	75.6	114.2	96.4	109.6	102.3
SS Gain	Mean	60.6[2]	46.4[1]	52.4[1]	76.1[2]	92.9[1]	58.1[1]	72.6[1]	19.4	54.9[1]	33.7[1]	63.4[1]	40[1]
	Std. Dev.	128.3	56.2	75.3	163.1	75.8	64.4	58.6	53.7	97.1	63.8	62.8	101.4
AM Gain % Control Gain	*t*	-0.729		0.96		-3.563		-3.354		-2.318		-2.266	
	p	0.468		0.34		<0.002		0.002		0.021		0.024	
Pre NCE	Mean	69.9	70.2	38.1	44.5	26.9	26.5	43.1	45.0	47.8	50.4	47.4	45.6
	Std. Dev.	18.8	15.5	15.6	20.4	6.3	7.2	16.3	16.4	19.1	20.7	16.3	16.1
Post NCE	Mean	81.8	75.0	44.0	49.0	41.4	33.3	52.8	43.3	55.3	51.5	55.3	15.9
	Std. Dev.	17.7	13.3	20.7	20.0	16.6	13.4	16.3	18.0	22.2	20.2	20.3	17.7
NCE Gain	Mean	11.9[1]	4.8[3]	6.0[2]	4.4	14.5[1]	6.8[1]	9.7[1]	-1.7	7.5[1]	1.1	7.9[1]	0.3
	Std. Dev.	16.2	15.7	15.3	17.1	15.9	12.5	12.7	11.4	16.7	14.6	15.0	15.3
AM Gain % Control Gain	*t*	-2.218		-0.449		-3.781		-3.348		-3.711		-4.114	
	p	0.029		0.654		<0.001		0.002		<0.001		<0.001	

C=Control Classroom; AM=Accelerated Math Classroom

[1] Gain significant at the $p \leq .001$ level.

[2] Gain significant at the $p \leq .01$ level.

[3] Gain significant at the $p \leq .05$ level.

With the exception of ELL control students, all groups achieved significant pre- to post-test gain as measured by STAR Math SS. Not all control groups achieved significant gain as measured by NCE scores, however, all Accelerated Math groups did. As in the whole group analyses, these findings indicate that students in these groups tended to improve over a single semester of math instruction. Far more noteworthy are the results of the t-tests comparing gain for control students to gain for students using Accelerated Math. Four of the six Accelerated Math groups—Low Achievers, ELL, FRL, and Title I— demonstrated significantly greater gains than their control counterparts in both SS and NCE. An additional group—G&T students—achieved significantly greater gains in NCE than its comparison group did.

Implementation and Gain for Groups Using Accelerated Math

We examined the extent to which each of the demographic and socio-economic groups used Accelerated Math in comparison to other students using Accelerated Math, to explore whether students in these specific groups appeared to benefit more from the intervention. We found considerable variation in the level of usage among the groups. However, in almost all cases, those students in the demographic and socio-economic groups had higher gain for similar implementation.

Gifted and Talented Students

There were 49 Accelerated Math students indicated as G&T. Of these, 21 were male and 28 were female. The students were predominantly white, with only 10 minority students included in the whole group (five using AM, five using control). Demographics for G&T students are shown in Table 5.

Table 5: Demographic Information for Students Indicated as Gifted and Talented

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
Asian	Males	1	1							1	1	2
	Females			1						1	0	1
African American	Males				1					0	1	1
	Females	1					1			1	1	2
Hispanic	Males	1	1	1					1	2	2	4
White	Males	5	4	5	5	8	5	4	3	22	17	39
	Females	8	7	6	14	7	6	3		24	27	51
Unspecified	Females	1								1	0	1
Totals		17	13	13	20	15	12	7	4	52	49	101

We conducted an Analysis of Variance contrasting Accelerated Math students indicated as G&T with those not indicated as G&T. We found significant differences in all indices of intervention implementation except the number of Accelerated Math objectives mastered in the student's major library. These results are shown in Table 6. G&T students mastered far more objectives outside their major library, indicating that these students were able to explore a broader range of mathematics topics than their non-G&T counterparts. These findings indicate that G&T students benefit from differentiated math instruction more than non-G&T students do, by allowing for advanced exploration of mathematics at an appropriately high level.

Table 6: Analysis of Variance Results for Gifted and Talented Students Compared to Non-Gifted and Talented Students Using Accelerated Math

	# of Students	# of Practice Problems Attempted	Average % Correct on Practices	# of Test Problems Attempted	Average % Correct on Test	# of Acc. Math Objectives Mastered	# of Acc. Math Objectives Mastered in the Major Library	Pre SS	Post SS	Pre NCE	Post Nce
								STAR Math Scale Score Gain		STAR Math NCE Gain	
Gifted and Talented Students	49	640	88.4	412	91.9	85	67	697	757	69.9	81.8
								60.6		11.9	
Non-Gifted and Talented Students	743	532	81.0	302	87.9	63	60	639	701	53.1	61.3
								61.5		8.1	
Difference		108	7.4	110	4.0	22	7	-0.9		3.8	
F		4.3	31.2	10.6	15.7	12.9	1.8	0.0		2.2	
Significance		0.039	<0.001	0.001	<0.001	>0.001	0.175	0.94		0.135	

Learning-Disabled, Special-Education, and Low-Achieving Students

Due to overlap among students indicated as learning disabled and those receiving special education, these two groups were combined for analysis. As these students traditionally achieve gains at a lower rate than non-learning-disabled students do, we were interested in comparing them to those students who scored below the 25th percentile on their STAR Math pretest. Therefore, in this section we report results for both groups of students. Tables 7 and 8 contain demographic information for each of the groups of students.

Table 7: Demographic Information for Students Indicated as Learning Disabled and/or Receiving Special Education

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
African American	Males	1	1		2	1	1			2	4	6
	Females			1						1	0	1
Hispanic	Males	2	3						1	2	4	6
	Females	1	1		1					1	2	3
Native American	Males		1							0	1	1
White	Males	3	5	7	12	5	4	4	9	19	30	49
	Females	3	5	1	8	3	2	3	3	10	18	28
Totals		10	16	9	23	9	7	7	13	35	59	94

Table 8: Demographic Information for Students Indicated as Low Achievers

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
African American	Males	2		1	6	3	3			6	9	15
	Females	1	2	4	1	5	3	1	1	11	7	18
Hispanic	Males		1					1		1	1	2
	Females		1	1				7		8	1	9
Native American	Males			5	4					5	4	9
	Females	1		3	1					4	1	5
White	Males	10	6	9	7	7	6	4	4	30	23	53
	Females	7	7	12	10	10	7	8	5	37	29	66
Unspecified	Males	2	2							2	2	4
	Females		4							0	4	4
	Unspecified			1		6	3			7	3	10
Totals		23	23	36	29	31	22	21	10	111	84	195

An Analysis of Variance contrasting the groups of students indicated that there were not significant differences in the level of intervention implementation for all indices. These results are shown in Table 9.

Table 9: Analysis of Variance Results for Learning-Disabled and/or Special-Education Students vs. Low Achieving Students Using Accelerated Math

	# of Students	# of Practice Problems Attempted	Average % Correct on Practices	# of Test Problems Attempted	Average % Correct on Test	# of Acc. Math Objectives Mastered	# of Acc. Math Objectives Mastered in the Major Library	Pre SS	Post SS	Pre NCE	Post NCE
								STAR Math Scale Score Gain		STAR Math NCE Gain	
Learning Disabled or Special Education Students	59	473	76.4	226	83.4	41	37	570	623	38.1	44.0
								52.4		6	
Low Achieving Students	84	518	74.3	239	83.7	43	41	520	614	26.9	41.4
								93.9		14.5	
Difference		-45	2.1	-13	-0.3	-2	-4	-41.5		-8.5	
F		0.6	2.0	0.2	0.0	0.1	0.7	10.5		10.2	
Significance		0.443	0.161	0.658	0.836	0.764	0.413	0.002		0.002	

We were somewhat surprised by the finding that low achievers demonstrated nearly twice the gain of LD students. This may be a function of the fact that the intervention period was relatively short, a time frame in which it may have been difficult for students with learning disabilities to profit. Because the LD group of students was enrolled in general education classes, it is unlikely that the students had severe disabilities. Such disabilities could have been another factor for why the low achievers gained more.

English-Language-Learner Students

Twenty-five students using Accelerated Math were indicated as ELL. Of these, most were Hispanic or Native American and more than half were in fourth grade. Demographics for ELL students are in Table 10.

Table 10: Demographic Information for Students Indicated as English Learners

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
Asian	Males							1	0	1	0	1
African American	Females						1			0	1	1
Hispanic	Males	3	4	1				1	1	5	5	10
	Females	2	1	2	3			3	2	7	6	13
Native American	Males			4	8					4	8	12
	Females			8	4					8	4	12
White	Unspecified								1	0	1	1
Totals		5	5	15	15		1	5	4	25	25	50

Analysis of Variance results showed that the only significant difference between ELL and non-ELL Accelerated Math students in terms of implementation indices was average percent correct on tests. These results are shown in Table 11. Nonetheless, ELL students showed directionally higher gains than non-ELL students, although the difference in gain scores is not significant. These results seem to indicate that Accelerated Math works as effectively for ELL students as it does for non-ELL students, although the small ELL student sample is cause for caution in interpreting these results broadly.

Table 11: Analysis of Variance Results for English-Language-Learning vs. Native-English-Speaking Students Using Accelerated Math

	# of Students	# of Practice Problems Attempted	Average % Correct on Practices	# of Test Problems Attempted	Average % Correct on Test	# of Acc. Math Objectives Mastered	# of Acc. Math Objectives Mastered in the Major Library	Pre SS	Post SS	Pre NCE	Post Nce
								STAR Math Scale Score Gain		STAR Math NCE Gain	
English Language Learning Students	25	576	79.1	298	85.7	56	52	592	665	43.1	52.8
								72.6		9.7	
Native English Speaking Students	710	528	81.6	303	88.4	64	60	649	709	54.7	63.1
								60.7		8.4	
Difference		48	-2.5	-5	-2.7	-8	-8	-9.5		1.3	
F		0.4	1.9	0.0	3.8	1.0	1.1	0.597		0.151	
Significance		0.508	0.163	0.928	0.050	0.314	0.29	0.44		0.698	

Students Receiving Free or Reduced Lunch and Title I Students

The largest of the demographic and socio-economic groups analyzed in this report—157 Accelerated Math students—was indicated as receiving free or reduced lunch. Additionally, 132 Accelerated Math students were designated as Title I. Due to the nature of the federal Title I program and the criteria for receiving free or reduced lunch, there is some overlap between the two groups of students eligible for each program. Of 132 Title I Accelerated Math students and 157 Accelerated Math students receiving free or reduced lunch, 56 are indicated as eligible for both programs. Of 138 Title I control students and 175 control students receiving free or reduced lunch, 51 are indicated as eligible for both programs. Rather than try to discern differential effects on students eligible for only one of the programs, we chose to leave dually designated students in the analyses for each group. For our purposes, designations of eligibility for either free or reduced lunch or Title I serve as proxies indicating low socio-economic status.

While there are a greater number of white FRL and Title I students, proportionally more minority students are FRL than are not. Demographics for these students are shown in Tables 12 and 13.

Table 12: Demographic Information for Students Indicated as Receiving Free or Reduced Lunch

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
Asian	Males				1			1	0	1	1	2
African American	Males	2	4	1	6	1	2		1	4	13	17
	Females	3	3	4	3	4			1	11	7	18
Hispanic	Males	6	8	1	1			1	4	8	13	21
	Females	8	3		2			8	4	16	9	25
Native American	Males			8	7					8	7	15
	Females	1	1	5	3					6	4	10
White	Males	10	14	25	25	12	10	13	10	60	59	119
	Females	15	11	25	14	12	6	8	13	60	44	104
Unspecified	Males					1				1	0	1
Totals		45	44	69	62	30	18	31	33	175	157	332

Table 13: Demographic Information for Students Designated as Title I

Race	Gender	Grade								Total		
		3		4		5		6				
Condition		C	AM	C	AM	C	AM	C	AM	C	AM	All
Asian	Males							1		1		1
African American	Males	2	3	1	5		1		1	3	10	13
	Females	1	2	5	3			1		7	5	12
Hispanic	Males	6	8					1	3	7	11	18
	Females	7	4					6	5	13	9	22
Native American	Females		1							0	1	1
White	Males	11	9	24	20	13	15	5	11	53	55	108
	Females	10	11	18	16	15	5	11	8	54	40	94
Unspecified	Males				1					0	1	1
Totals		37	38	48	45	28	21	25	28	138	132	270

Students receiving free or reduced lunch and Title I students had significantly lower average Accelerated Math practice and test percent correct and mastered significantly fewer objectives than non-FRL and non-Title I students. Despite this apparently lower level of mastery, FRL and Title I students gained about the same in terms of both SS and NCE than non-FRL and non-Title I students. Analysis of Variance results for FRL and non-FRL students are shown in Table 14. Analysis of Variance results for Title I and non-Title I students are shown in Table 15.

Table 14: Analysis of Variance Results for Students Receiving Free or Reduced Lunch vs. Students Not Receiving Free or Reduced Lunch Using Accelerated Math

	# of Students	# of Practice Problems Attempted	Average % Correct on Practices	# of Test Problems Attempted	Average % Correct on Test	# of Acc. Math Objectives Mastered	# of Acc. Math Objectives Mastered in the Major Library	Pre SS	Post SS	Pre NCE	Post Nce
								STAR Math Scale Score Gain		STAR Math NCE Gain	
Students Receiving Free or Reduced Lunch	157	588	78.2	297	85.9	56	50	607	662	47.8	55.3
								54.9		7.5	
Students Not Receiving Free or Reduced Lunch	577	550	82.4	328	88.6	70	66	648	713	55.2	64.0
								64.4		8.9	
Difference		38	-4.2	-31	-2.7	-14	-16	-9.5		-1.4	
F		1.4	27.6	2.2	18.7	14.9	25.9	1.928		0.839	
Significance		0.236	<0.001	0.135	<0.001	<0.001	<0.001	0.165		0.36	

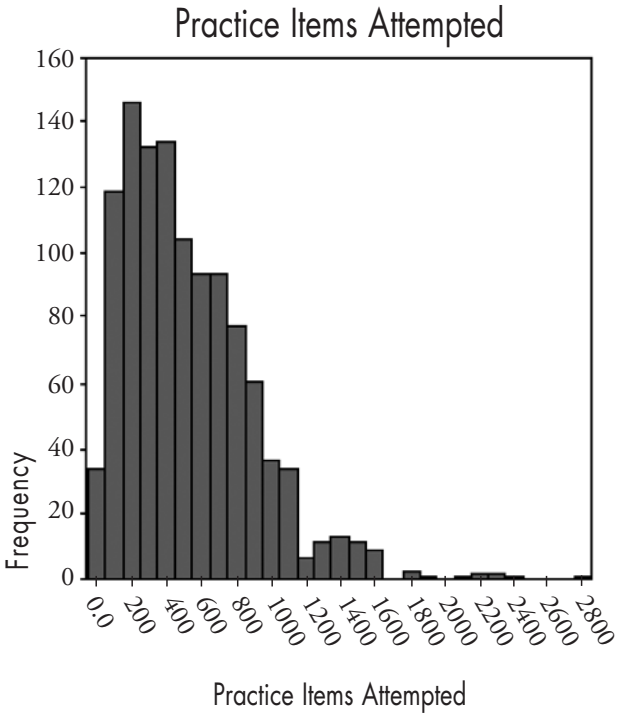
Table 15: Analysis of Variance Statistics for Title I Students on Select Accelerated Math Implementation Factors

	# of Students	# of Practice Problems Attempted	Average % Correct on Practices	# of Test Problems Attempted	Average % Correct on Test	# of Acc. Math Objectives Mastered	# of Acc. Math Objectives Mastered in the Major Library	Pre SS	Post SS	Pre NCE	Post Nce
								STAR Math Scale Score Gain		STAR Math NCE Gain	
Title I Students	132	562	78.1	282	84.8	52	48	606	670	69.9	81.8
								63.4		11.9	
Non-Title I Students	660	534	82.2	341	88.8	67	62	650	711	55.5	64.0
								61		8.5	
Difference		28	-4.1	-32	-4	-15	-14	2.4		-0.6	
F		0.7	23.8	2.2	37.9	14	18.3	0.105		0.117	
Significance		0.415	<0.001	0.142	<0.001	<0.001	<0.001	0.746		0.732	

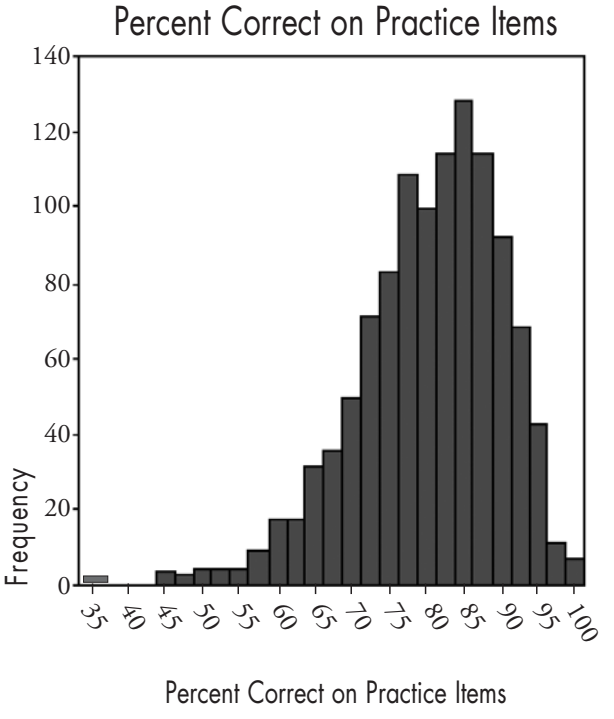
Intervention Integrity

We examined variability in implementation of the Accelerated Math program across all classrooms and students (see graphs in Figure 2). We looked at the frequency distributions for the numbers of practice items and test items attempted, the percent correct on practice items and test items, and the numbers of objectives mastered. There was a considerable range in the numbers of practice items and test items attempted. Percent correct for both practice items (average=80%) and test items (average=87%) was very high. There also was considerable variability in the numbers of objectives mastered. Based on our finding of considerable variability in these indices of intervention implementation, we decided to examine the extent to which student outcomes were a function of the extent to which the teacher implemented the program as it was intended to be implemented.

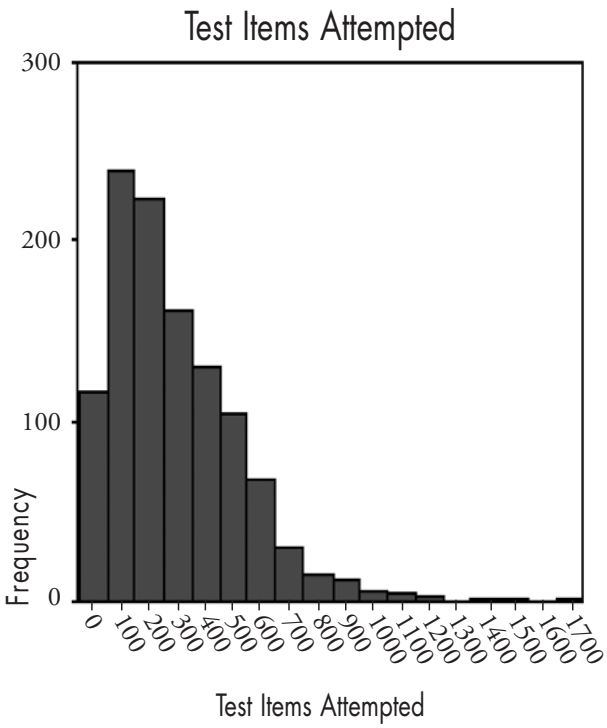
Figure 2: Frequency Distribution for Implementation Indices



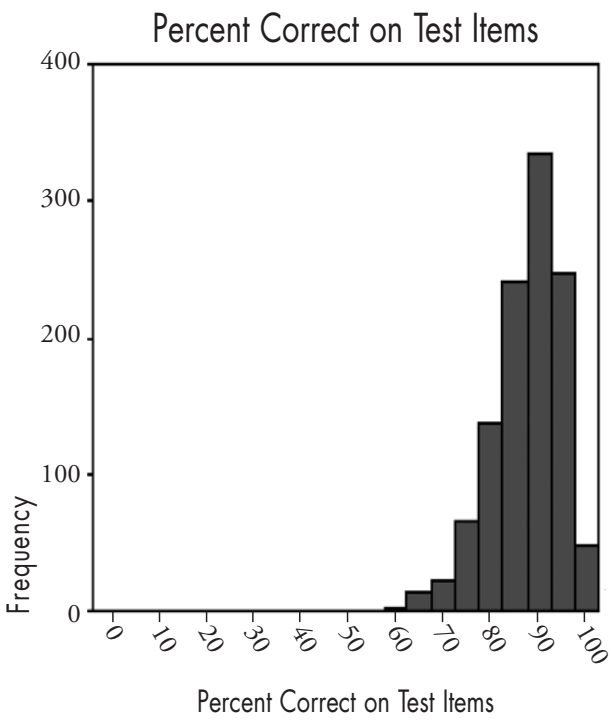
Std. Dev = 379.07
Mean = 527.4
N = 1131.00



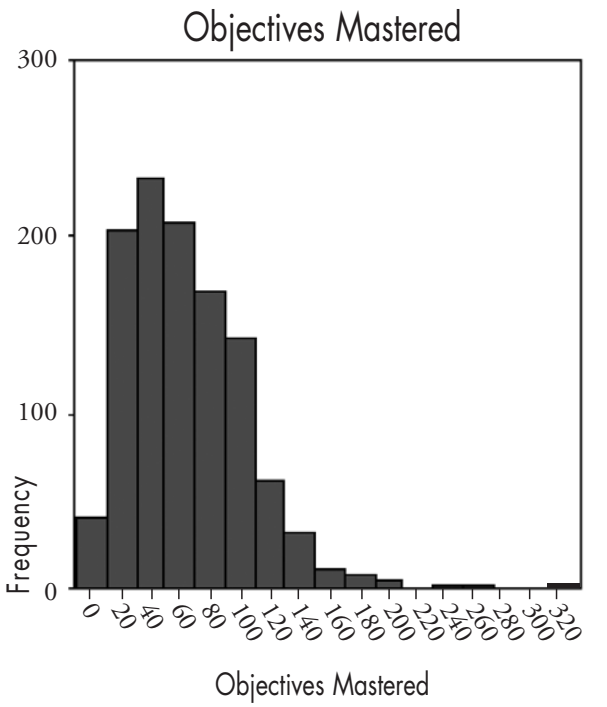
Std. Dev = 9.86
Mean = 80.3
N = 1131.00



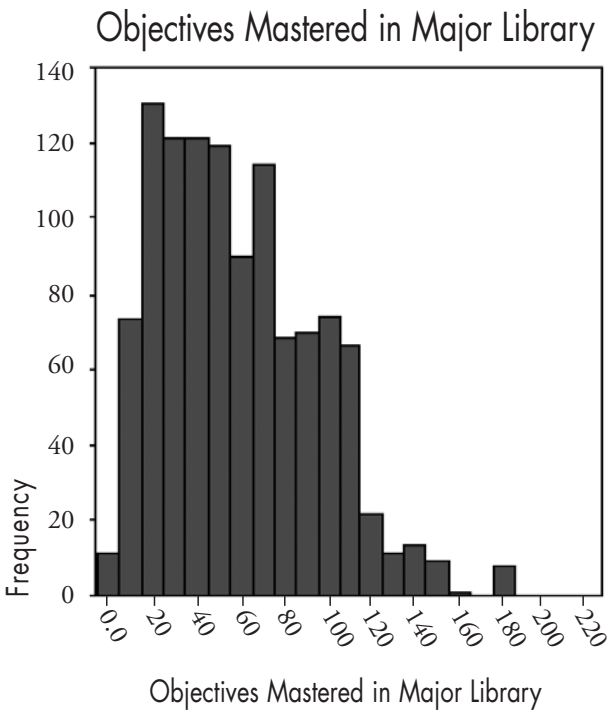
Std. Dev = 234.29
Mean = 294.9
N = 1131.00



Std. Dev = 8.18
Mean = 87.1
N = 1131.00



Std. Dev = 42.05
Mean = 63.9
N = 1131.00



Std. Dev = 36.43
Mean = 59.5
N = 1131.00

We examined the extent to which gains in math performance were a function of the integrity (or fidelity) with which the teacher implemented the program. We used as our first index of intervention integrity the numbers of objectives mastered. Students participated in the Accelerated Math intervention for about one-half year. We computed the percent of full pace for students at each grade level. The results are shown in Table 16. We show half the number of objectives in a full year library for the grade level, the median objectives mastered by students in the experimental group, and the percent of full pace represented by students in each grade. Implementation was great in grades three and five, mediocre in grades four and six, and very poor in grades 7/8.

Table 16: Intervention Integrity as Measured by the Percent of Full Pace Toward Mastery of Grade Level Library

	Grade				
	3	4	5	6	7 and 8
Half of objectives in grade level library	57	73	91	110	97
Median objectives for grade	53	40	73	39	8
Percent of Full Pace	93%	55%	80%	35%	8%

A second analysis was conducted to assess the extent to which results (i.e. gains in math performance) were related to intervention integrity. First we computed the cutoff numbers of objectives mastered by students at the 25th, 50th, and 75th percentile at each grade level. These scores are shown in Table 17.

Table 17: Mean, Median, and Quartile Objectives Mastered by Grade

	Grade				
	3	4	5	6	7 and 8
Mean Objectives Mastered	54	47	77	50	26
Median Objectives Mastered	53	40	73	39	8
25th Percentile	15	22	47	23	0
50th Percentile	53	40	73	39	8
75th Percentile	76	72	101	71	43

*The number of objectives varies by grade level

We conducted an Analysis of Variance contrasting students in the bottom fourth (below 25%) for objectives mastered with those in the top fourth. We found that there was a significant difference between these groups in gain on STAR Math (p<.01) in grades four, five, and six. The difference at grade three was not statistically significant at the p=.05 level.

We then conducted one additional analysis to investigate the relationship between intervention integrity and results. While objectives mastered is a useful criterion of integrity of implementation, it is the case that some students master many objectives with relatively low percentage correct on the tests of those objectives and others master few objectives with high percentages correct on the tests. We conducted a regression analysis to see how well pretest NCE score on STAR Math and level of implementation (number of objectives mastered X proportion of average items correct on tests) predicted the post-test score on STAR Math. Both variables were significant predictors (p<.001). Level of implementation had a definite, significant effect on gain in math performance across the entire sample.

Use of Supplemental Implementation Assistance

Teachers in the experimental group were asked to fax Accelerated Math reports bi-weekly to Renaissance Learning. Upon receipt, Renaissance consultants analyzed the reports for evidence of implementation integrity. The consultants followed up the analysis with phone consultations with the participating teachers to assist with implementation. The degree to which teachers in the experimental group took advantage of this support varied.

To conduct the analysis of supplemental implementation assistance, we first computed the number of times teachers contacted supplemental implementation consultants regarding student diagnostic reports. We divided the distribution into three roughly equal groups: 7 or fewer contacts (N=337), 8 to 13 contacts (N=345), and 14 or more contacts (n=449). We then contrasted the gains in NCE scores on STAR Math for students in the two extreme groups (< 7 contacts, > 14 contacts). We ran these analyses separately for each grade level.

Results of the analysis are shown in Table 18. With the exception of sixth grade, there were no significant differences in gains for students in classes of teachers who were high users and low users of intervention assistance; however there were significant differences in the number of objectives mastered for students in grades 5, 6, and 7/8. Intervention assistance (as indicated by sending in a diagnostic report) did not consistently translate to gains in student performance. It simply is likely that gains are related to multiple factors. It may well be that those who sent in reports did not act on the assistance they received, or that consultants were unable to speak to teachers directly following receipt of a report. We have already demonstrated that integrity of implementation is a major factor affecting outcomes.

Table 18: NCE and SS Gain by Supplemental Implementation Assistance Contacts

	Grade											
	3		4		5		6		7 and 8		9 and 10	
	<7	>14	<7	>14	<7	>14	<7	>14	<7	>14	<7	>14
N	52	70	40	136	87	183	94	31	37	29	27	0
Mean Gain NCE	7.4	13.8	11.3	8.5	8.4	6.7	3.4	9.7	7.6	1.8	3.9	
Std. Dev.	21.8	16.4	12.4	16.4	14.3	17.0	15.2	13.9	11.3	15.9	16	
Difference	6.4		-2.8		-1.7		6.3		-5.8		NA	
t	1.85		1.02		0.79		2.03*		1.73			
Mean Gain SS	56.6	87.1	74.5	67.1	57.4	48.8	36.8	80.3	45.1	17.3	25.6	
Std. Dev.	110.4	62.0	49.1	66.0	58.3	71.9	71.4	61.9	54.2	17.3	80.0	
Difference	30.5		-7.4		-8.6		43.5		-27.8		NA	
t	1.94		0.65		0.98		3.03*		1.71			

* Significant at the $p<.05$ level.

What Can One Expect When Accelerated Math is Implemented With High Fidelity?

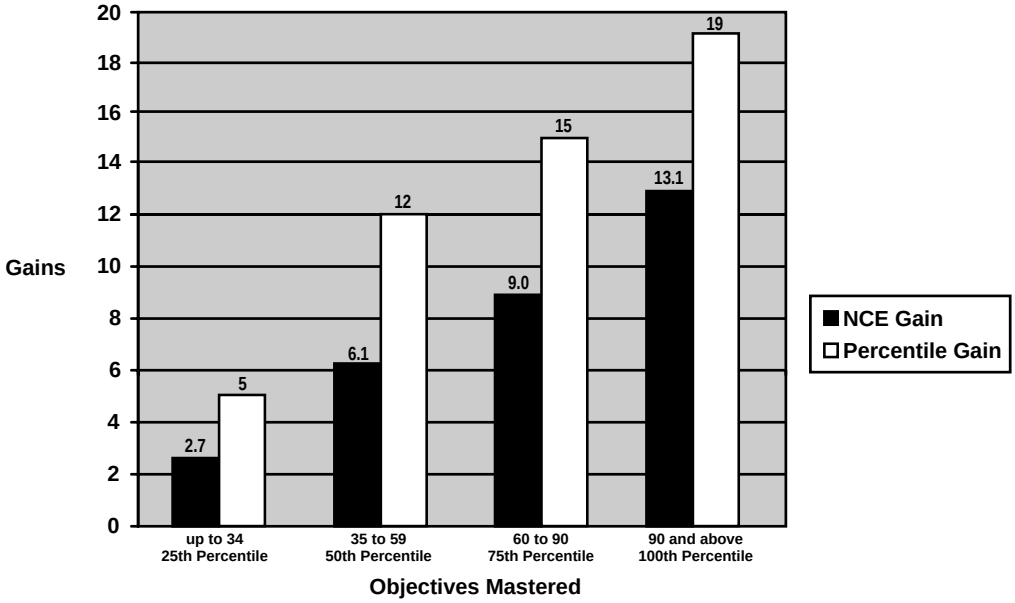
Those who use products like Accelerated Math typically want to know "What kinds of results for students can I expect if I implement this program as it is intended to be implemented?" Essentially, this is a fidelity of treatment question. Renaissance Learning designed Accelerated Math with the expectation that good implementation is evidenced when students are on pace for mastering a library of objectives within one school year. And, it is expected that good implementation is reflected in students achieving average success rates above 85% on the tests administered for each of the objectives in a library. For students who were achieving an average of 85% correct on the tests, we examined the numbers of practice problems they were attempting, their percent correct on test problems, the number of test items they were attempting, and their gains in math performance as measured by STAR Math. Across the entire sample, students gained an average of 9.1 NCEs, an average of 64 scaled score points, an average of 11 percentile points, and an average of 1.5 grade equivalents in five months of intervention. In Table 7 we show the results disaggregated by grade level. Again we stress the fact that these are gains that were achieved in one semester of intervention with a program that was put in place in the middle of an academic year. Results of these analyses are shown in Table 19.

Table 19: Average Gains for Spring Semester for Students with >85% Correct on Accelerated Math Tests

	Grade				
	3	4	5	6	7 and 8
NCE Gain	9.8	9.3	9.3	8.5	6.2
SS Gain	72.2	66.7	61	62.2	40.3
Percentile Gain	11.4	12.2	10.6	9.7	7.1
GE Gain	1.1	1.3	2	2	1.3
Objectives Mastered	75	57	87	60	52

In Figure 3 we show the results of analysis contrasting gains in NCEs, and percentile points for students in each of the quartiles for objectives mastered in grades three through six, combined. Students in the top quartile gained an average of 13 NCEs, while those in the bottom quartile gained 2.7 NCEs. Clearly highly significant gains can be expected for students when the level of implementation is high.

Figure 3: Gain in NCE and Percentile by Objectives Mastered Quartile



An ideal implementation would take into account both the number of objectives mastered and the average percent correct on Accelerated Math tests. Students in classrooms with high implementation should be averaging at least 85% correct on Accelerated Math tests and be on pace to complete a library within one school year. Because this intervention was introduced in the middle of a school year, we considered students on pace if they had mastered 80% of half the objectives in their library. Therefore we looked at average gains for students who met both of the above criteria. Results are shown in Table 20.

Table 20: Average Gains for Spring Semester for High Implementing Students* (n = 361)

	Pretest	Post-Test	Gain	*p*
SS	656.5	736.4	79.9	<.001
NCE	60	72.4	12.4	<.001
Percentile	68	86	18	
GE	4.8	6.4	1.6	
Average Objectives Mastered			96	

* Students averaging >85% correct on Accelerated Math tests and with >80% of objectives mastered on pace. A student "on pace" will finish the grade level library they are working in within an academic year. As this was a one semester intervention, pace was considered to be half the objectives in the grade level library a student worked in the majority of the time.

It should be no surprise that this group of high-implementing students showed significantly more gain than control group students. The gain figures for these two groups are shown in Table 21.

Table 21: Comparison of Average Gain for Spring Semester for High Implementing Students and Control Students

		Pre	Post	Gain	Difference	*p*
SS	Control	654.0	684.9	30.9	49	<.001
	AM High	656.5	736.4	79.9		
NCE	Control	52.8	53.8	1.0	11.4	<.001
	AM High	60.0	72.4	12.4		
Percentile	Control	55.0	57.0	2.0	16	
	AM High	68.0	86.0	18.0		
GE	Control	4.8	5.3	0.5	1.1	
	AM High	4.8	6.4	1.6		

Teacher Survey Results

A teacher survey was administered at the conclusion of the study to obtain information about instructional practices used by the teachers, their practices in assigning homework, and their views of the extent to which students were profiting from instruction in math. Sixty-one teachers who had used Accelerated Math and 47 control-group teachers returned the survey.

Results of the survey are shown in Table 22. We learned several things from the survey. First, instructional practices changed. As reported in earlier studies (Spicuzza, Ysseldyke, Lemkuil, Kosciolek, Boys, & Teelucksingh. (2001); Ysseldyke, Spicuzza, Kosciolek & Boys (2003)), teachers who use Accelerated Math spend more time providing individual instruction and less time providing group instruction than do those in control group classrooms. Second, there are major changes in student academic engaged time. Sixty-nine percent of teachers who used Accelerated Math versus 55% of control group teachers report that their students spent more than 30 minutes per day actively engaged in math practice other than testing.

Third, we were interested in the amount of homework assigned to students as an alternative explanation for the observed differences in gains by students in the experimental and control groups. Teachers of students in the control groups assigned more homework than the teachers using Accelerated Math (57% versus 36% assigned homework more than three days per week).

Table 22: Teacher Survey Results (total n = 108)

	% indicating more than 30 minutes		Mean Response		Mean Difference
About how much time each day, on average:	Control (n=47)	AM (n=61)	Control	AM	
did you spend on whole group math instruction with this class?	57%	23%	2.67[1]	2.00	.67*
did you spend helping individual students with math?	19%	41%	2.00	2.39	.39**
did this class spend engaged in math practice?[2]	55%	69%	2.70	2.98	.29
did it take students in this class to complete the math problems that they were supposed to work on at home?	11%	13%	1.81	1.93	.12
	% indicating more than 3 days/week				
About how often did you assign math problems to be worked on at home to this class?	57%	36%	2.70[3]	2.47	.23
	% indicating more than 4 days/week				
Approximately how many times do you have to interrupt this math class to deal with student misbehavior or disruption?	13%	18%	1.68[4]	1.82	.14
The students in this class:	% indicating Agree or Strongly Agree				
enjoy math.	60%	80%	3.59[5]	4.02	.43**
take responsibility for their math work.	57%	82%	3.49	3.90	.41[&]
are learning basic math skills better this year.	36%	80%	3.33	3.98	.66*
are learning higher-order thinking and problem-solving skills better this year.	32%	75%	3.23	3.92	.69*
are mastering math topics faster this year.	30%	70%	3.23	3.77	.55**
I have the information I need to diagnose individual student difficulties in the class.	47%	92%	3.17	4.38	1.21*
It is easier this year to meet the needs of individual students in my math class who evidence a wide range of levels of skill development in math.	15%	82%	2.65	4.30	1.65*
It is easier to manage math instruction this year than last year.	32%	66%	3.13	3.87	.74*
I have difficulty teaching math as the instructional program intends it to be taught.	19%	10%	2.61	2.32	.29

* Difference significant at the $p < .001$ level. ** Difference significant at the $p < .01$ level.

[&] Difference significant at the $p < .05$ level.

[1] Responses based on a 4-point Likert scale. (1 = < 15 minutes; 4 = > 45 minutes)

[2] Math practice time includes any time students spent working on, correcting, or discussing problems in a non-testing situation.

[3] Responses based on a 4-point Likert scale. (1 = Never; 4 = Every day)

[4] Responses based on a 4-point Likert scale. (1 = Once per day or less; 4 = More than 5 times per day)

[5] Responses based on 5-point Likert scale. (1= Strongly Disagree; 5 = Strongly Agree).

The other teacher-survey questions were focused on qualitative reports of teachers' views of the effects of Accelerated Math on student behavior, performance, and progress. There were huge significant differences in favor of those who participated in Accelerated Math on all qualitative factors. Teachers reported that significantly more Accelerated Math participants enjoy math (80% versus 60%), and take responsibility for their math work (82% versus 57%). Teachers who used Accelerated Math either agreed or strongly agreed with qualitative indices of the extent to which students were performing better. Again huge differences were noted in the extent to which teachers either agreed or strongly agreed with these statements: "Students are learning basic math skills better" (80% Accelerated Math participants versus 36% controls), and "Students are mastering math topics faster" (70% Accelerated Math teachers versus 30% controls). Finally, and importantly, teachers indicated that the Accelerated Math program helped them teach. When asked whether they "have the information they need to diagnose individual student difficulties in this classroom," 92% of Accelerated Math teachers agreed or strongly agreed that they did, whereas only 47% of control teachers said they did. When asked whether it was easier this year to meet the math instructional needs of individual students who evidence a wide range of skill levels, 82% of Accelerated Math teachers and only 15% in the control group agreed or strongly agreed with this statement. In fact, while 52% of the experimental group strongly agreed with the contention that it was easier to meet individual students needs, none of the control group strongly agreed with this statement. Finally, 66% of teachers who used Accelerated Math versus only 32% of control group teachers agreed or strongly agreed with the statement that it is easier to manage math instruction this year than last year.

Teachers' views of Accelerated Math were extremely positive. They indicate that the program brings about positive changes in student performance and outcomes, and that students enjoy math and take responsibility for their work. Most importantly, those teachers who used Accelerated Math indicate that it is easier to manage individual differences and meet the needs of a very diverse group of learners. Readers should recognize that these strongly favorable outcomes were achieved without sorting from the experimental group the three teachers who actually did not use Accelerated Math with their classes.

Student Survey Results

Students were asked to respond to 10 questions focused on their instructional experiences in math and their attitudes toward math. A total of 2,169 students responded to the survey (1,206 Accelerated Math participants, 963 students in control group classrooms). Results of the survey are shown in Table 23. There were significant differences between groups ($p<.05$) in response to six questions. Significantly more students who participated in Accelerated Math reported that they like math, help each other with math more, and like math better this year than last year. Significantly more control group students reported that the math class is too easy, math tests make them nervous, and sometimes the math teacher goes too fast. Observed differences are conservative estimates of differences in the impact of the program on students because the results may include approximately 200 students in the experimental group who did not actually participate in the Accelerated Math program.

Table 23: Student Survey Results (total n = 2,169)

	% Agreeing		*p*
	Control	AM	
I like math.	69.2%	75.0%	.005*
I think I am good at math.	71.0%	72.6%	.407
I like working on the math problems I get in this class.	65.6%	67.9%	.205
We get to work with each other in small groups when we do math.	52.1%	49.3%	.197
We help each other with math work.	67.7%	81.7%	<.001*
The math in this class is too easy for me.	30.7%	26.2%	.016*
Math tests make me nervous.	51.2%	45.1%	.005*
Sometimes in math class the teacher goes too fast for me.	43.3%	36.0%	<.001*
I like math better this year than last year.	69.8%	74.6%	.022*
I used Accelerated Math in my math class	0%	100%	NA

* Difference between groups is significant at the $p < .05$

Conclusions

Implementation of Accelerated Math as a curriculum-based instructional management system had significant and profound positive effects on the performance of students in grades three through six. Results in grades 7 through 10 were mixed, largely as a function of sample size, length of intervention, implementation issues, and the limited sensitivity of the dependent measure (STAR Math) to the curriculum of students at this level.

In general, students who received Accelerated Math as an enhancement demonstrated significantly higher gains in math achievement than students who did not participate in the Accelerated Math program. We followed up the main study by conducting a set of supplemental analyses on specific subgroups. In this subgroup analysis we reported on the performance of students who are gifted and talented, learning disabled or special education, low achievers, English language learners, eligible for free or reduced lunch, or Title I.

Accelerated Math had a significant effect in all respects for students who are gifted and talented, low achieving, English language learners, eligible for free or reduced lunch, and Title I. The intervention did not produce significant effects for students with learning disabilities or those eligible for special education services. We think that, overall, this is good news. Implementation of Accelerated Math results in improved performance

for students at multiple points on the ability/disability spectrum. We demonstrated that, in general, the program works. And, in this set of supplemental analyses, we demonstrated that Accelerated Math is effective for students who are gifted and talented, low-achievers, English language learners, or in poverty.

Consistently, students who participated in Accelerated Math outperformed those who did not. A major finding of this large study was that intervention integrity is a crucial factor affecting the success of the program. In schools today there are major differences in the extent to which teachers implement instructional interventions in a manner consistent with the publisher's intended implementation. It is not surprising to learn that when teachers do not implement the program, or do so in a half-hearted way, the students do not benefit from it. This is like finding that patients who do not take their doctor-prescribed medications do not benefit from those medications. We were able to demonstrate that when the program is implemented with a high degree of intervention integrity, results are outstanding. However, even when intervention integrity was modest, gains were still significant.

We examined the extent to which students enrolled in classes of teachers who make use of supplementary implementation assistance profit more than those enrolled in classes of teachers who do not use this assistance. The initial results were not statistically significant with respect to NCE gain although students of teachers who used the assistance showed higher levels of implementation. It may be that teachers sought implementation assistance but did not use the suggestions of the consultants

In addition to the strong positive gains in math performance we were able to demonstrate that student's attitudes toward math improve with the use of Accelerated Math. And, we showed that teacher's reports of student performance and progress under the two treatment conditions strongly favored those who participated in Accelerated Math.

The strong positive gains evidenced in this study were achieved by implementing Accelerated Math for only one semester, and putting the intervention in place in mid-year. The results were very impressive given the timing and length of time of the study. Accelerated Math is a powerful intervention for improving math outcomes for students.

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