

G r e a t S o u r c e

Afterschool Achievers: Math Club

Research Base and Program Efficacy

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NOTES ABOUT THIS DOCUMENT

About the Test: The test scores included in this document are taken from the pre- and post tests included in the *Afterschool Achievers: Math Club* program.

Statistical Information: The statistical information included in this document is take from the 2002-2003 MDR directories, published by Market Data Retrieval. This is included to give general background information on the districts included in this document. The students who participated in the *Afterschool Achievers: Math Club* are a subset of the district population.

AFTERSCHOOL ACHIEVERS: MATH CLUB PROGRAM OVERVIEW

Afterschool Achievers: Math Club is a complete, easy-to-use afterschool kit packed with a full year of fun, enriching activities aligned with the NCTM standards. Each grade-level specific kit, grades K-8, covers all the major math strands through daily 20-30 minute activities that:

- provide meaningful daily practice that will improve students' confidence and proficiency with number sense, basic operations, algebra, geometry, measurement, mental math, and problem solving;
- engage students through thought-provoking activities that encourage participation and enjoyment in learning math;
- prepare students for testing by offering consistent, yearlong practice across a variety of math strands;
- help students develop an understanding of how different types of math problems are related and solved through basic problem-solving strategies.

Flexible and ready-to-use, *Afterschool Achievers: Math Club* provides effective and thought-provoking activities that will get students excited about learning math.

Each grade-level specific kit includes:

- Instructor's Guide with step-by-step implementation instructions, detailed daily lessons, diagnostic tests, and daily assessment guidelines;
- Student Book copymasters (also available as consumable Student Books);
- Cardstock for Math Jumble Activities;
- Math Jumble activity poster;
- 36 decks of Math Maze games (cardstock);
- 36 scientific calculators (grades 6-8 only);
- 24 number cubes (grades 6-8 only).

Afterschool Achievers: Math Club

Research Base

Introduction

Education in the United States is receiving renewed focus from current and emerging federal policies. Under the No Child Left Behind legislation, all students in grades 3-8 will be tested in mathematics by 2005 to ensure that every child achieves in math. Additionally, as more school districts implement the recommendation of the National Council of Teachers of Mathematics that all students enroll in algebra by grade 8 (NCTM, 2000), they must find ways to make sure that students get the prerequisite skills they need to enroll in the higher-level math courses they will need to be successful in school and in life.

Afterschool programs that offer students extra time with math can help struggling students increase their proficiency and students who achieve in math opportunities to excel. Afterschool programs offer the added benefit that students who might otherwise be unsupervised can spend their time in a safe place with opportunities for social and academic enrichment. As a result, many districts and families are interested in programs to supplement their curriculum by means of mathematics programs designed to extend the regular school day.

Extended learning time is associated with increased student achievement.

Afterschool Achievers: Math Club enhances existing mathematics programs by providing students with extended learning time in mathematics. Additional time spent with mathematics is linked to increased student achievement in the regular classroom (i.e. Miller, 2001). Students who participate in the *Afterschool Achievers: Math Club* program receive 20-30 minutes of hands-on, engaging math instruction each day in addition to what they receive in class. Increased time spent with mathematics in the *Afterschool Achievers: Math Club* can help students improve on areas of weaknesses that may not be addressed in a typical classroom (Thomas, 1984; Kane, 1994).

Participation in afterschool programs is associated with reduced risk of juvenile delinquency, drug use, violent crime victimization, and pregnancy.

Students who participate in a high-quality afterschool program such as the *Afterschool Achievers: Math Club* also benefit in other ways. Students are most likely to commit a crime or fall victim to criminal behavior in the hours immediately following school (U.S. Departments of Education and Justice, 2000). Students who participate in afterschool programs are less likely to fall prey to juvenile delinquency, drug abuse, violent crime, victimization, and pregnancy (Chung, 2000; U.S. Departments of Education and Justice, 2000). Students in the *Afterschool Achievers: Math Club* are involved in a supervised program that is engaging, fun, and helps them achieve academic success. Students work with other students who are likewise improving their mathematics skills and knowledge in a safe and secure setting.

Mathematics instruction in afterschool programs should provide engaging mathematics content that complements what students learn during the regular school day.

Participation in a high-quality afterschool program such as the *Afterschool Achievers: Math Club* provides more than simply increased time with mathematics. As students engage in the various activities of the program they make and test conjectures, collect data, make applications of mathematics to real-world settings, and connect mathematics to other disciplines such as science and history. The program spans all the major math strands with topics drawn from the Principles and Standards of School Mathematics (2000), developed by the National Council of Teachers of Mathematics. Alignment with NCTM standards ensures that students will be working on content that is similar to what students see in class but in an engaging format that is fun and engrossing.

Students in grades K-1 work with simple patterns, shape recognition, counting, matching, and spatial visualization skills. Students in grades 2 and 3 expand their understanding of patterns, solve increasingly difficult open sentences, identify geometric figures, and develop their knowledge of time and money. Students in grades 4 and 5 focus on number operations, more complex patterns, and measurement and rational number concepts. Students in grades 6-8 work on number sense, geometry, estimation, measurement, spatial visualization, place-value concepts, meaning of fractions and decimals, proportional reasoning, collection, organization and display of data, pattern recognition, and use of variables to express relationships (NCTM, 2000).

At-risk students benefit from a non-threatening learning environment with opportunities to increase proficiency through engaging math activities.

Although not exclusively designed as a remediation program, *Afterschool Achievers: Math Club* can benefit at-risk students. In addition to the extended school day and increased amount of time spent on mathematics, the *Afterschool Achievers: Math Club* can assist these marginalized students in other ways. Most at-risk students lack confidence in their mathematics. Their confidence in mathematics can grow as a result of positive experiences (Raths, Waserman, Jonas, & Rothstein, 1986). With *Afterschool Achievers: Math Club* students gain confidence from working in a non-threatening atmosphere with other students. They establish a base line of their mathematics ability and begin to advance their mathematics by virtue of the motivating problems, games, and activities in the program. At-risk students also benefit from the interchange of opinions and findings with other students during explorations. Such discussions enable them to construct their personal, valid understanding of the mathematics at hand. The opportunity to build a personal understanding of mathematics greatly benefits at-risk students (Pugalee, 2001).

Cooperative learning engages students, encourages them to share their thinking, and helps students to learn from each other.

An integral aspect of *Afterschool Achievers: Math Club* is that children have many opportunities to work together in pairs or in small, cooperative groups. "Cooperative learning promotes the use of effective reasoning strategies and greater critical thinking than do individual learning strategies." (Johnson, Johnson, Holube, & Roy, 1984). Students learn to work with others in a collaborative effort. They explain their thinking to a partner or a group, work with others to explore mathematics concepts, and present their findings to the whole group.

Cooperative settings promote a positive attitude towards mathematics, as well as continuing to motivate children (Johnson et al., 1984). In their group each child does his or her share of the explorations. Thus, children share their thinking with others and benefit from hearing how others thought about and then solved a particular problem (Mueller & Fleming, 2001).

Continuous exposure to critical math concepts, allows students to develop an understanding of important mathematical concepts over time and learn at an individual pace.

Numerous mathematics skills and concepts are developed over time in *Afterschool Achievers: Math Club*. Students confront a specific skill, (i.e. working with money) in different settings and in different question formats during the program. They may make change, represent a specific amount in different ways, or select the coins needed to purchase a particular item. This strategy allows students to learn at an individual pace and to continually review as they move through the program. Such an approach has proven to be an effective way to maintain skills and an understanding of critical mathematical concepts (Baratta-Lorton, 1994).

Daily whole-class discussion encourages social interaction and dialogic discourse, which are important components of learning mathematics and help develop deeper understanding of key concepts.

Many of the cooperative activities culminate in whole-class discussions. These daily discussions work to foster interaction among all the students and promote dialogue about mathematics. During these discussions students exchange ideas and approaches to mathematical topics which helps them develop a deeper understanding of various mathematics concepts as they compare and contrast different ways to view and solve problems (Schoenfeld, 1992). Furthermore, daily discussion benefits students by providing them opportunities to express their thinking before a group in a non-threatening, secure setting. In such an environment students are less likely to feel nervous and reluctant to participate. This also allows students to improve their socialization skills.

One result of this exchange of ideas and strategies is that students build their own understandings of mathematics concepts, based on their discussions. Their understanding is deeper than that gained by memorizing a teacher's examples. "Children who have the opportunity to consistently construct their personal understandings of mathematics concepts are more mathematically powerful than those who do not" (Kamii, 1993). Research clearly supports the superior depth and stability of the mathematical concepts that children construct for themselves based on effective experiences provided by the *Afterschool Achievers: Math Club* (von Glasenfeld, 1995; Kamii, 1993). When children have built their own personal understandings, they have a more solid grasp of the concept and a stronger base on which to build future concepts. They also are able to recall and apply these concepts in a far better way than if they had learned them by rote memorization.

Programs that provide informal learning, games, and tasks that challenge students without overwhelming them, motivate and engage students in the learning process.

The content of the mathematics in the *Afterschool Achievers: Math Club* program is drawn from topics that are appropriate for each grade level, but is not simply a repetition of what students see in class. Participants solve thought-provoking puzzles and logic problems which are rich in mathematical content and application that will improve their mathematical abilities. Students continue to be interested in mathematics because the activities of the *Afterschool Achievers: Math Club* are not simply drill and practice. Students search for patterns, make and test engrossing conjectures, and discover interesting mathematics concepts. They navigate through Math Mazes, simplify Math Jumbles, and solve a variety of puzzles. In addition to being engaged, these various tasks promote an interest in mathematics and a determination in children to learn more interesting aspects of mathematics. While doing so, students improve their skills and understanding of mathematics at their level (O'Conner & McGuire, 1998).

Another aspect of participating in a high-quality afterschool program is the effect on the general attitude students have about mathematics. Many younger children are interested in all school subjects, but their interest in mathematics wanes as they approach the upper elementary school grades. Students involved in supplemental mathematics programs are more likely to have a positive attitude towards mathematics (Bransford, Brown, & Cocking, 2000). Children in the *Afterschool Achievers: Math Club* work with mathematics concepts in compelling problem settings. The activities are designed to maintain student interest in mathematics by putting mathematics in engaging types of problems that focus on major concepts rather than rote drill and memorization. Students will learn that mathematics can be appealing and fun.

Meaningful, ongoing assessment helps students achieve.

Assessment is an integral part of the *Afterschool Achievers: Math Club*. It includes assessment in the form of pre- and post-tests to allow schools to evaluate program effectiveness and track student performance and informal, ongoing assessment that helps teachers tailor instruction and teaches students to monitor their mastery of a particular concept or topic.

The informal assessment is not cumulative, occurring after a number of weeks, but is ongoing, and provides students the opportunity to demonstrate mastery at several opportunities in addition to daily checks of understanding. Students reap the benefits of immediate assessment by correcting any flawed reasoning and applying this corrected thinking to subsequent problems. The assessment is in line with the National Council of Teachers of Mathematics recommendations for effective assessment in mathematics classrooms (NCTM, 1995).

After every activity children receive immediate feedback and then individually rate their progress. The assessment in the *Afterschool Achievers: Math Club* extends to assessing peers. Children regularly prepare problems and questions for others to answer. They then compare their peers' answers with their own, and discuss any differences within their groups or with the whole class.

Test preparation should be integrated into ongoing instructional activities and familiarize students with test format so that they don't miss test questions solely because they misunderstand the design of the test.

One facet of the *Afterschool Achievers: Math Club* that is especially noteworthy is that it will help prepare children for high-stakes tests, whether local, regional, or national. During the course of the *Afterschool Achievers: Math Club* program students regularly solve Rule Out Two problems. In Rule Out Two, children examine multiple-choice questions with four potential answers. Students are given valuable experience in eliminating some of the potential answers by using reasoning skills even before they try to solve the problem itself. When taking high-stakes tests, many students know the mathematics needed to answer a test question but can be confused by the presentation of material. They may miss the question because of the question format, and not because they did not know the mathematics involved.

In a typical classroom students rarely have the opportunity to examine test questions. The focus is on the mathematics that is queried by the test question. *Afterschool Achievers: Math Club* provides children with valuable experience with the format of test questions. As children examine common types of test questions, they improve their ability to answer them, as well as knowledge about the math involved in the questions. As a result, the question format is no longer a challenge to children, and they can concentrate on the mathematics of test questions when taking high-stakes tests (Ligon, 1982; Mehrens, 1989). They are comfortable taking high-stakes tests because they have successfully solved problems with the same format.

NCTM supports the use of calculators in the classroom and while calculators can help students achieve, inappropriate calculator use is associated with lower math scores. *Afterschool Achievers: Math Club* for middle school teaches appropriate calculator use.

As part of the curriculum, students make use of calculators in their explorations. "Electronic technologies—calculators and computers—are essential tools for teaching, learning, and doing mathematics" (NCTM, 2000). The middle school kits include calculators with directions on when and how to use them, including appropriate keys strokes. The appropriate use of calculators has been linked with elevated learning and improved test scores. "Using calculators with children of all ages enhances children's learning of mathematical concepts and skills, problem solving, and attitudes towards mathematics" (Hembree, 1992). However, in *Afterschool Achievers: Math Club* calculators are not used exclusively, and children also learn and practice their basic math facts.

Summary

The *Afterschool Achievers: Math Club* program format is similar at every grade, ensuring continuity throughout the program from kindergarten to grade 8. The topics and challenges at each grade are aligned with NCTM standards and build on what students learn in class with activities that engage students, allowing them to explore, make and test conjectures, and apply their mathematics. The activities regularly include games and explorations that students find captivating. While involved in these activities, students are learning motivating and interesting mathematics concepts and relationships, which promote an interest in mathematics and in learning in general. The *Afterschool Achievers: Math Club* promotes children's socialization skills as they enjoy discussions about mathematics. They are part of activities and explorations that are age-appropriate, involving topics that are suitable for their respective grade levels, in a safe, secure environment.

See page 12 for research bibliography.

Jane Addams Elementary School, Lawndale, CA

Jane Addams Elementary School is part of the Lawndale School District. The following statistical information is for the entire Lawndale School District:

Schools: 9

Teachers: 289

Students: 6,067

Special Education Students: 775

Poverty: 16%

Ethnic: Asian 9%, African American 18%, Hispanic 63%, Caucasian 10%

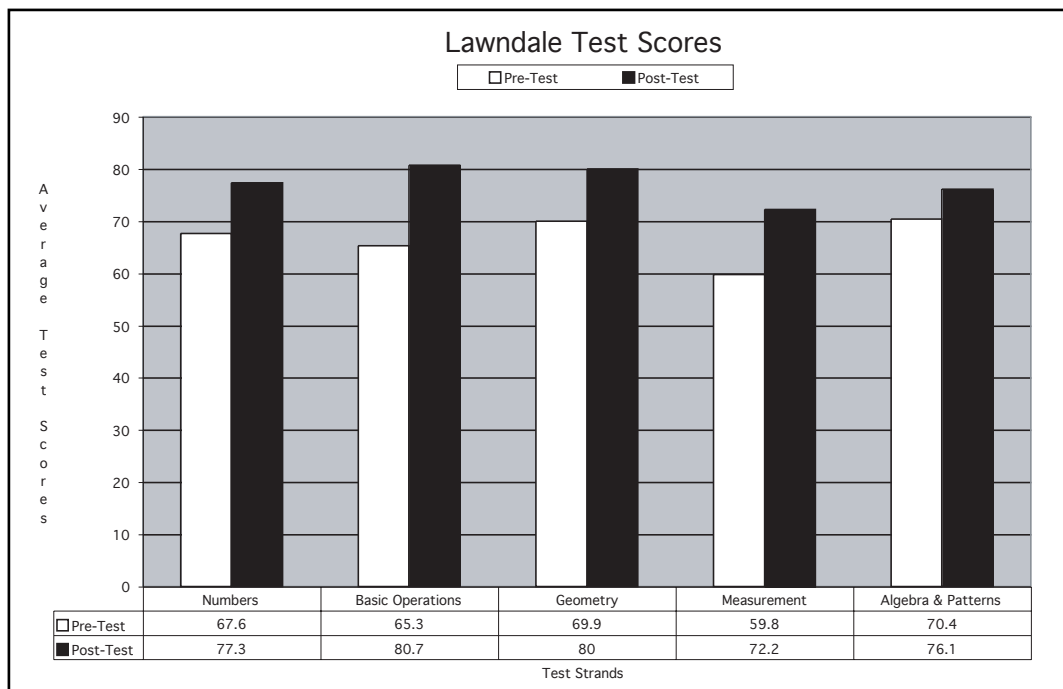
Jane Addams Elementary School:

Grades: K-6

Enrollment: 850

Afterschool Achievers: Math Club Test Scores

The chart below shows the progress students made from the pre-test to the post-test for *Afterschool Achievers: Math Club*. Implemented in grades K-5, *Afterschool Achievers: Math Club* helped student test scores in math rise across participating grade levels. The greatest increase in test scores was in basic operations (average increase of 15 points), followed by measurement (12 points), then geometry and numbers (10 points each).



Monterey Peninsula Unified School District, California

J. C. Crumpton Primary School and Marina Vista Elementary School are part of the Monterey Peninsula Unified School District. The following statistical information is for the entire Monterey Peninsula Unified School District:

Schools: 25

Teachers: 616

Students: 12,321

Special Education Students: 1,510

Ethnic: Asian 17%, African American 14%, Hispanic 28%, Native American 1%, Caucasian 39%

J. C. Crumpton Primary School

Marina, CA

Grades: Pre-K-5

Enrollment: 473

Marina Vista Elementary School

Marina, CA

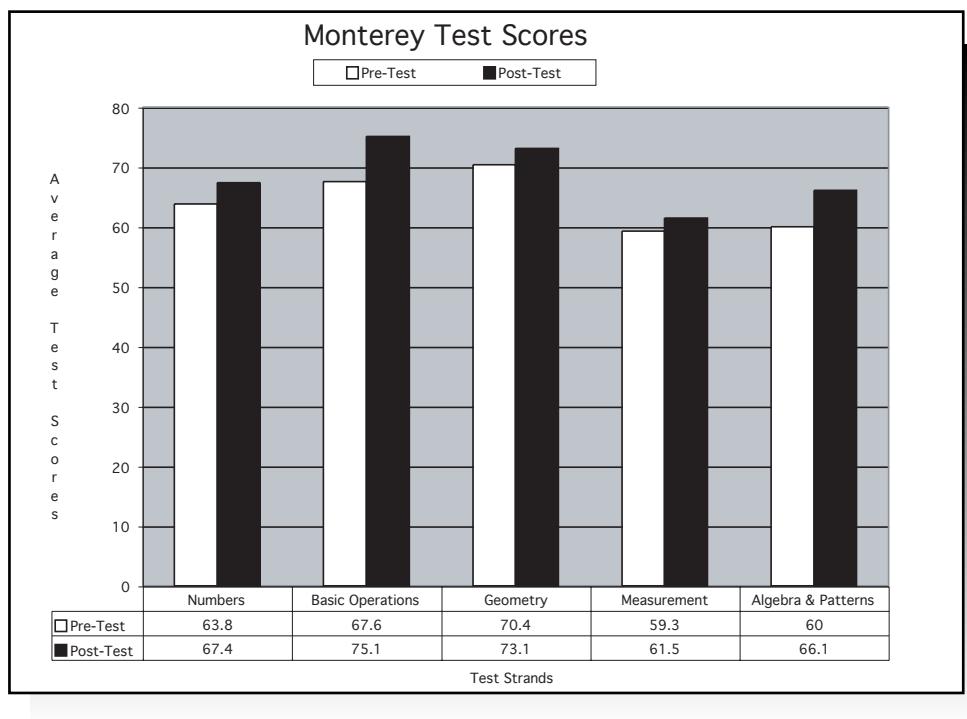
Grades: Pre-K-5

Enrollment: 420

Title I Schoolwide

Afterschool Achievers: Math Club Test Scores

The chart below shows the progress students made from the pre-test to the post-test for *Afterschool Achievers: Math Club*. Implemented in grades K-5, *Afterschool Achievers: Math Club* helped student test scores in math rise across participating grade levels. The strongest increase in test scores was in basic operations and measurement (average increase of 7 points each), followed by algebra and patterns (6 points each).



Monterey Peninsula Unified School District, California, cont.

About Afterschool Achievers: Math Club

“The program is excellent. The students enjoyed it as it was not the typical textbook issue. In fact, teachers also expressed the fact that it was easier to work with. The students are able to recognize the area they need most help on and feel very confident at recognizing the areas they know very well.”

Yinka Osborne, Teacher
Crompton Elementary School
Marina, CA

“The most successful part of the program was its variety. The students enjoyed doing different activities on different days. It was not the same materials they were looking at all day long. We didn’t hear moans and groans when we pulled it out every day.”

Patsy Oxford, Site Coordinator
Marina Vista Elementary School
Marina, CA

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