

Summer Success[®]: Math

Research Base and Program Efficacy



TABLE OF CONTENTS

SUMMER SUCCESS: MATH PROGRAM OVERVIEW .....	.3
SUMMER SUCCESS: MATH RESEARCH BASE .....	.4-8
USER SURVEY DATA .....	.9
NATIONAL EVALUATION OF PROGRAM EFFECTIVENESS .....	.10
BROCKTON SCHOOL DISTRICT (BROCKTON, MA) .....	.11
MONROE PUBLIC SCHOOLS (MONROE, MI) .....	.12
JULIA P. BRYANT SCHOOL (STATESBORO, GA) .....	.13
CHEYBOYGAN SCHOOL DISTRICT (CHEYBOYGAN, MI) .....	.14
LOWELL ELEMENTARY (LIMA, OH) .....	.15
NORTH BAYOU ELEMENTARY (ALEXANDRIA, TX) .....	.16
KATY INDEPENDENT SCHOOL DISTRICT (KATY, TX) .....	.17
REFERENCES .....	.18

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 *Summer Success: Math* program.

Statistical Information: The statistical information included in this document is taken from the 2003-2004 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 *Summer Success: Math* are a subset of the district population.

SUMMER SUCCESS: MATH PROGRAM OVERVIEW

Summer Success: Math is a complete and comprehensive summer-school math program created to build students' confidence and proficiency in math. Aligned with the NCTM Standards, each grade-level specific kit is packed with everything a teacher needs to implement a full summer school course that introduces, reinforces, and reviews key concepts for students. Student materials are available in Spanish on CD-ROM.

Kit Resources:

- A **Teacher's Edition** with comprehensive weekly activity planners, detailed lesson plans, pre-and posttests, test preparation strategies, and daily assessment guides;
- **Copymasters** for student activity pages, also available as consumable English or Spanish Student Books;
- **Number Names strips** for the bulletin board;
- **Cardstock game materials** and counters;
- **Blank dice** for games;
- **Recording Pads** for the Number Names Wall.

Summer Success: Math

Research Base

Introduction

For students who struggle with mathematics, summer school offers the opportunity for focused review and re-teaching of key math concepts and skills to help prepare them for advancement to the next grade level. Challenges for summer school teachers include diverse student needs, little instructional planning time and, often, a lack of appropriate teaching materials that are different from the approach used during the school year. The *Summer Success: Math* kits, designed specifically for summer school instruction, provide teachers with all the materials they need to implement a summer school mathematics program that will meet the needs of a wide range of students. *Summer Success: Math* is comprised of five key elements—Number Names, Games, Practice, Make & Take, and Assessment—each offering content that aligns with and helps teachers implement the National Council of Teachers of Mathematics Standards for each grade level. In addition to the math content, the variety of activities within the program offers a mixture of whole-group instruction and individual practice to help students preview, learn, and review math topics.

Daily whole-class discussion encourages social interaction and dialogic discourse to help promote a deeper understanding of key concepts.

Communication is a fundamental aspect of mathematics and mathematics education. The National Council of Teachers of Mathematics Communication Standard calls for all students to “organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; [and] use the language of mathematics to express mathematical ideas precisely” (National Council of Teachers of Mathematics [NCTM], 2000). By making communication the centerpiece of *Summer Success: Math*, students learn to articulate their understanding and can listen to their peers to learn and solidify their knowledge through explanation and discussion. Teachers can listen and observe to assess learning (Copley, 2000). When students have opportunities to talk about their mathematical understanding, learning mathematics becomes natural (Cobb, Yackel, and Wood, 1991). Instruction through discourse and collective reflection helps children achieve mathematical understanding. Whitin and Whitin discovered “[T]alking was an effective way for children to clarify their thinking, discuss new possibilities, [and] extend the thinking of others” (Whitin & Whitin, 2002). Cobb states in his observations of first-grade students, “the children did not happen to spontaneously reflect on a prior activity at the same moment. Instead, reflection was supported and enabled by participation in discourse” (Cobb, Boufi, McClain, & Whitenack, 1997).

“Language has a distinctive orienting function (Maturana & Varela, 1980), and classroom discourse can exploit this function to orient students’ attention to mathematical relationships of interest Communication among the students and teachers is enhanced because all participants can focus their attention on the same entities and relationships between entities In fact, the language used to talk with others about materials may be crucial for students in constructing relationships (Greeno, 1988b; Resnick & Omanson, 1987)” (Heibert & Carpenter, 1992).

In *Summer Success: Math*, daily discussions involving Number Names provide repeated, daily opportunities for students to grasp key concepts, learn by listening to each other's explanations of solutions, and see patterns develop through visual models. 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 that help them develop a deeper understanding of various mathematics concepts as they compare and contrast different ways to view and solve problems and learn from each other (Schoenfeld, 1992; NCTM, 1989). Furthermore, daily discussion benefits students by providing them opportunities to express their thinking before a group in a non-threatening, secure setting.

"The establishment of a classroom participation structure that provides students with opportunities to explain and justify different solutions allows teachers to build on students' contributions as they move toward desired pedagogical goals. This discourse is central to reform and makes possible students' development of mathematical beliefs and values that contribute to the development of their intellectual autonomy" (McClain & Cobb, 1999). 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, Lewis, & Livingston, 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. "When children talk about mathematical concepts, they are actually increasing their understanding of that concept. Language allows them to reflect on and revise their thoughts" (Andrews, 1997).

Understanding number and developing number sense is the foundation of mathematics instruction.

"All the mathematics proposed for prekindergarten through grade 12 is strongly grounded in number" (NCTM, 2000). The Number Names activities focus on a specific number each day ranging from whole numbers in early elementary to fractions and decimals in upper elementary and negative numbers, exponents, and square roots in middle school. Number Names, the daily focus of the whole-group instruction and discussion, also helps students connect key math concepts from different mathematical strands including number sense, basic operations, problem solving, patterns and algebraic thinking, measurement, geometry, and data analysis. This aligns with the National Council of Teachers of Mathematics Standard that students in all grade levels be able to "recognize and use connections among mathematical ideas; [and] understand how mathematical ideas interconnect and build on one another to produce a coherent whole" (NCTM, 2000).

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

"Group games can provide rich context for social and mathematical development" (Hildebrandt, 1998). In *Summer Success: Math*, students work in pairs or in small groups to practice their math skills through games. With a focus on the skills required for each grade level, the games reinforce the concepts discussed during the Number Names time and provide ongoing work with number facts, computation, mental-math strategies, reasoning, and problem-solving

strategies while providing hands-on, verbal, and auditory experiences. In addition to being fun, *Summer Success: Math* games help students practice their math skills and apply problem-solving strategies. “[Games] incorporate virtually every curricular standard set forth by the National Council of Teachers of Mathematics (1989), most specifically, estimation, probability, and operations. It seems only natural that educators should increase their use of games in the classroom, since playing them is an important human activity that affords substantial opportunities to experience and explore mathematics within the context of culture” (Barta & Schaelling, 1998). *Summer Success: Math* games help students develop mathematical competence and confidence, build their critical thinking and problem-solving skills, and provide opportunities for students to learn from each other through discussion. As students make moves, toss number cubes, and draw cards during the games, they share their answers along with the reasoning behind their answers, allowing them to teach and learn from each other.

Practice is an integral aspect of the study of mathematics.

“The role of practice in mathematics, as in sports and music, is to be able to execute procedures automatically without conscious thought” (National Research Council, 2001). The Practice activities in *Summer Success: Math* provide paper-and-pencil practice to reinforce key math concepts through ongoing work with number facts, computation, strategies, and problem solving. A variety of daily practice problems focusing on important math topics builds students’ confidence and competence in math and helps them build a deeper understanding of mathematics and mathematical relationships. A journal section on each practice page helps reinforce students’ understanding of topics by providing a special place for them to write or draw their explanations of new concepts.

Parental involvement improves student achievement.

Family involvement is a powerful influence on children’s achievement in school (Henderson & Berla, 1994; U.S. Department of Education, 1994; Ziegler, 1987). Higher grades and test scores, more consistent completion of homework, and trying harder in school are all linked with parental involvement (Desimone, 1999; Epstein, 1995). For these reasons, increasing family involvement in the education of children is an important goal for schools, particularly those serving low-income students and other students at risk of failure. *Summer Success: Math* includes weekly newsletters in English and Spanish plus at-home extension activities to encourage parental involvement and keep parents informed about student progress. The weekly newsletters provide parents with an overview of the week’s Make & Take activities and suggestions for how they might be used for additional practice at home. The parent involvement and other take-home activities complement the work students do in the classroom and encourage the link between home and school activities to help students get the most out of summer school.

Meaningful, ongoing assessment helps students achieve.

“Assessment should be more than merely a test at the end of instruction to see how students perform under special conditions; rather, it should be an integral part of instruction that informs and guides teachers as they make instructional decisions” (NCTM, 2000). Assessment is an integral aspect of *Summer Success: Math*. The program includes assessment in the form of pre- and post tests to allow schools to evaluate program effectiveness and track student

performance. The pretest is correlated to the grade-level core curriculum and written to match the format found in state and national tests. The pretest is administered during the first class and the results are used to help teachers tailor instruction to students' individual needs. Each week, teachers select five items from the pretest and discuss successful strategies for solving each problem. In addition, *Summer Success: Math* provides informal, ongoing assessment that helps teachers monitor students' mastery of a particular concept or topic. Daily informal assessment questions provide ongoing assessment for the teacher to consider each day. The informal assessment also 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).

Offering children multiple points of entry helps them construct mathematical knowledge.

By presenting mathematical concepts orally, visually, and kinesthetically, each child can move the information into long-term memory in a manner that works best for him or her. It is these deep and sustained interactions with key mathematical ideas that enable children to acquire mathematical understanding (National Association for the Education of Young Children & National Council of Teachers of Mathematics [NAEYC & NCTM], 2002). *Summer Success: Math* is based on the information gleaned from brain research and the understanding that young children must actively construct mathematical knowledge. Elements of the program such as the Games and Make & Take activities allow students multiple points of entry through a variety of modalities and activities that are connected, or related.

"The challenge of teaching any subject is to find learning activities that are accessible to all learners and, at the same time, have the richness to challenge the more interested or capable students. Manipulative materials are a wonderful resource for this" (Burns & Silbey, 2000). The use of manipulative materials and visual models promotes students' problem solving ability. "Classroom lessons involving manipulatives have a higher probability of producing greater mathematics achievement than do lessons not using manipulatives" (Johnson, 2000). *Summer Success: Math* uses a variety of manipulatives such as cardstock game pieces, counters, and dice to help students to better visualize and understand the mathematical concepts.

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

An integral aspect of *Summer Success: Math* is that students 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). The Games activities in *Summer Success: Math* allow students to work in pairs or small groups to practice their math skills. In their group, each student does his or her share of the explorations. Children then share their thinking with others and benefit from hearing how others thought about and then solved a particular problem (Mueller & Fleming, 2001).

Mathematics instructional materials should be accessible for all students.

Summer Success: Math appeals to students with many different learning styles and backgrounds including English language learners. The visual, verbal, kinesthetic, social, and interpersonal aspects of the program not only help make mathematics accessible to all students but also help students in their overall academic achievement. A study of limited English proficiency students funded by the Office of Educational Improvement found that children learn best when they are given a relevant context for their learning. For example, for students learning a new language, “[r]ather than participating in structured skill-and-drill practice selected and directed by the teacher, these students are practicing English by using it to communicate their own ideas to each other and to the teacher” (McLeod, 2004). During the whole-class discussions, students are given numerous, tangible real-world contexts for their learning. As a result, students internalize important concepts quickly and are able to communicate their understanding to others and connect it to new topics. To help teachers address the needs of Spanish-speaking students, a Spanish CD-ROM is available including complete translations of all the student materials and key components of the *Summer Success: Math* kit.

Summary

The content of the mathematics in the *Summer Success: Math* program is drawn from topics that are appropriate for each grade level, but is not simply a repetition of what students have already seen in class during the regular school year. Students review the content from the previous school year through a variety of new and different activities. In *Summer Success: Math*, students are engaged in mathematics because the activities in the program are not simply drill and practice. Students gather together as a class to discuss the Number Names wall, play games in small groups, and practice computation activities on their own. In addition to being engaging, 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).

See page 18 for research base references.

USER SURVEY DATA

534 teachers nationwide participated in a *Summer Success: Math* survey regarding their use of the program.

- Subjects taught during summer school this year:

Math	100%
Reading	75%
Language Arts	40%
Social Studies	5%
Other	4%

- Amount of time spent each day in summer school on math:

60 minutes or less	23%
61-120 minutes	65%
2 hours+	13%

AVERAGE: 99 minutes

Using information from the administrative survey, amount of time spent on math throughout the summer school program was calculated to be:

20 hours or less	18%
21-30 hours	48%
31-40 hours	14%
41-60 hours	13%
over 60 hours	8%

- Percent of teachers using instructional materials other than *Summer Success: Math*: 80%

Other instructional materials used:

Manipulatives	73%
Worksheets/practice sheets	69%
Games	63%
Other	Computer–Leap Frog 4%; others are under 2% each
Published Programs	Accelerated Math 2%; others are under 1% each

- Time spent using *Summer Success: Math* each day:

30 minutes or less	14%
31-45 minutes	13%
46-60 minutes	27%
61-75 minutes	10%
76-90 minutes	22%
over 90 minutes	14%

AVERAGE: 70 minutes

NATIONAL EVALUATION OF PROGRAM EFFECTIVENESS

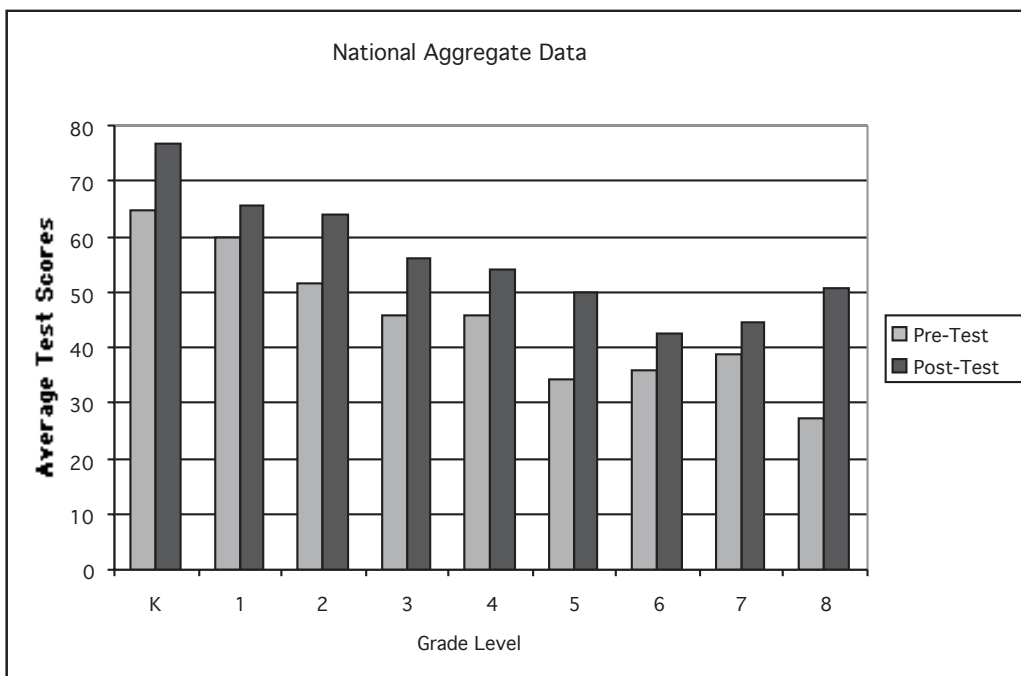
A comparison between pre-test scores at the beginning of the *Summer Success: Math* program and post-test scores at the end of the course reflects significant improvement in students' math proficiency in schools and districts nationwide.

Data collected from schools and districts during the summer of 2001 include data from 4747 students in grades K-8.

Distribution of students across grade levels:

Total	K	1	2	3	4	5	6	7	8
4747	303	799	785	1038	883	518	316	55	50.72

	K	1	2	3	4	5	6	7	8
Pre-Test Average Score	64.92	59.60	51.45	45.95	45.95	34.34	35.73	38.90	27.03
Post-Test Average Score	76.90	65.70	64.04	56.12	56.12	49.87	42.58	44.60	50.00



Brockton School District (Brockton, MA)

The Brockton School District is an urban district in Massachusetts. The following is statistical information for the entire Brockton School District:

Schools: 27

Students: 16,495

Special Education Students: 2,130

College Bound Students: 78%

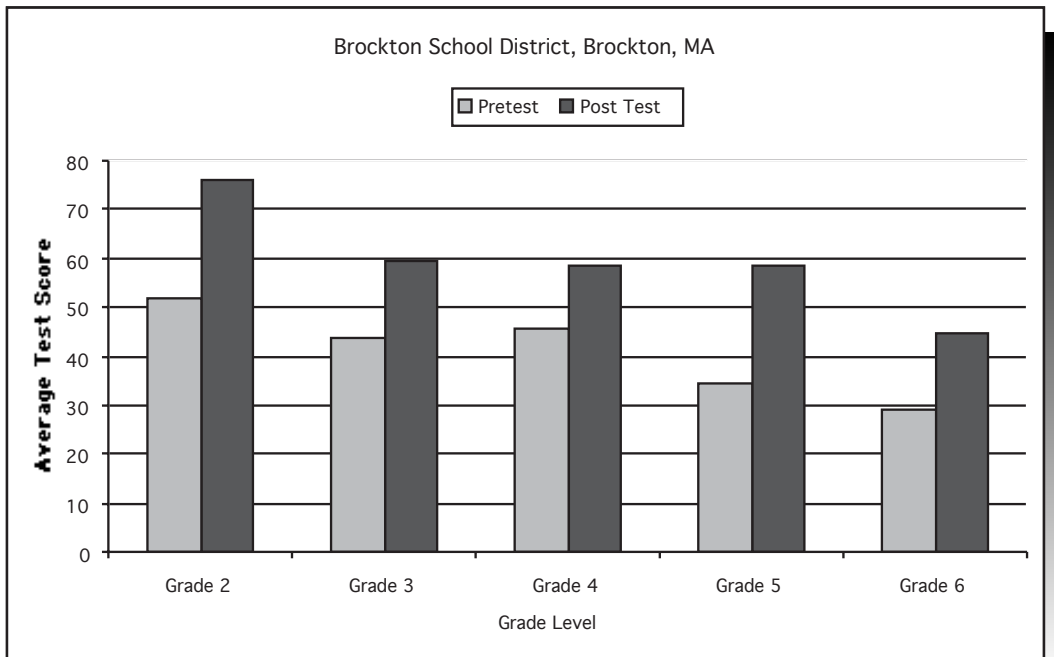
Ethnic: Asian 3%, African American 43%, Hispanic 11%, Native American 1%,Caucasian 41%

Poverty: 19%

Schools in the Brockton School District recorded a significant increase in test scores at the end of the *Summer Success: Math* program. Implemented in grades 2-6, the program helped student test scores rise by at least 15.68% across participating grade levels with some grades improving by as much as 23.97%.

“My students loved the ‘Make and Take’ games. They were motivational and the students were thrilled to bring them home to use.”

Elizabeth A. Zack, Teacher
Angelo School
Brockton, MA



Monroe Public Schools (Monroe, MI)

The following statistical information is for the entire Monroe Public School District:

Schools: 13

Teachers: 355

Students: 6,900

Special Education Students: 927

College Bound Students: 48%

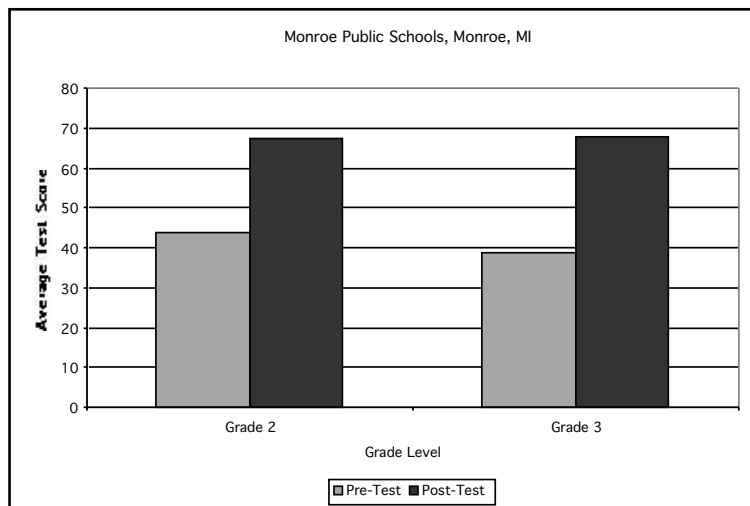
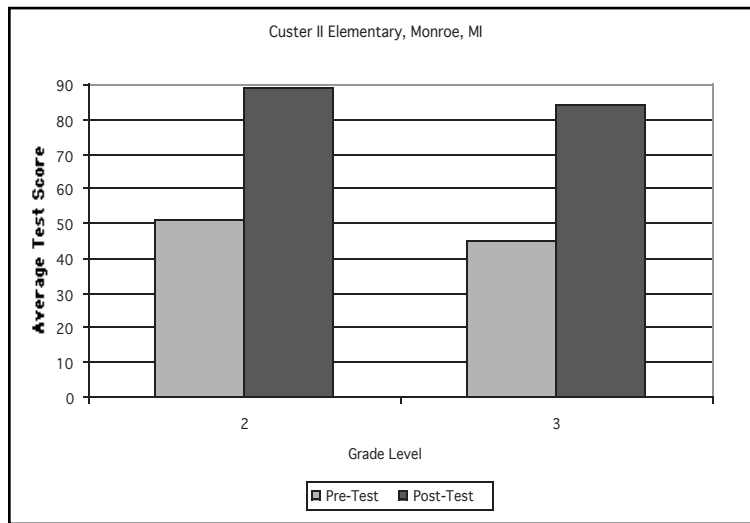
Ethnic: Asian 1%, African American 7%, Hispanic 3%, Caucasian 89%

Poverty: 12%

The Monroe Public School District implemented *Summer Success: Math* in grades 2 and 3. The district overall reported an impressive 29.37% improvement in posttest scores at the end of the program with one specific school, Custer II Elementary School, achieving an increase of close to 40% at both grade levels.

“All my students showed an improvement and enjoyed all the hands-on activities.”

Kelli S. Krukowski, Teacher
Custer II Elementary School
Monroe, MI



Julia P. Bryant School (Statesboro, GA)

Julia P. Bryant School is part of the Bulloch County School District. The following statistical information is for the entire Bulloch County School District:

Schools: 16

Teachers: 582

Students: 8,198

Special Education Students: 1,238

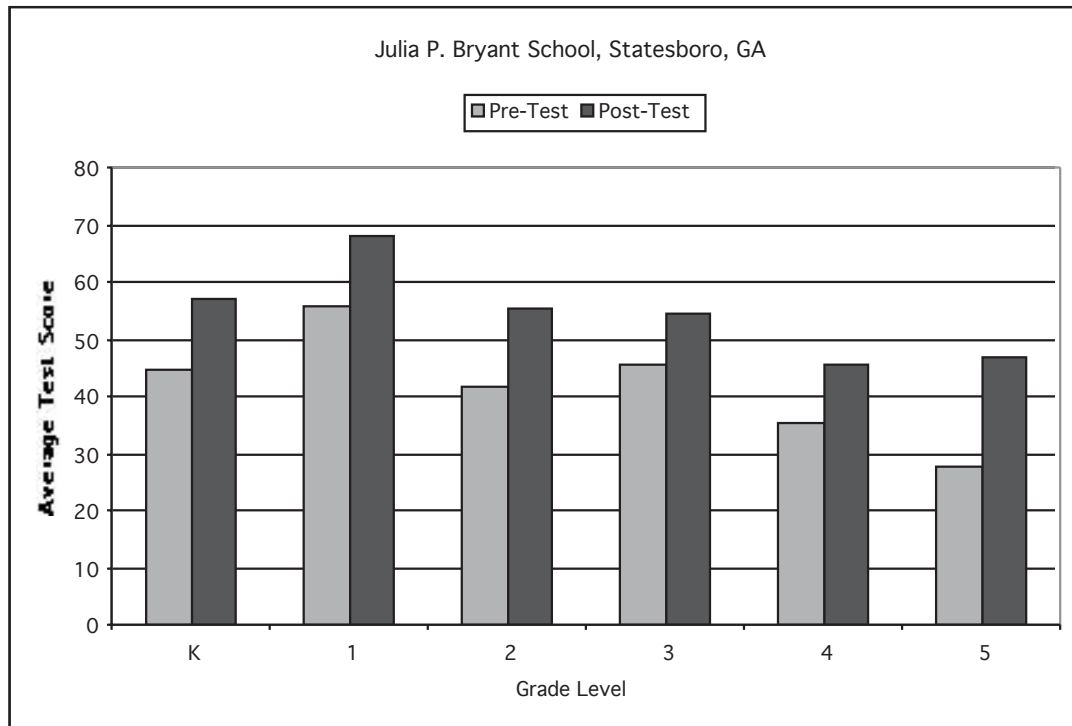
Ethnic: Asian 1%, African American 38%, Hispanic 1%, Caucasian 60%

Poverty: 19%

Summer Success: Math was the basis for the summer school math curriculum for grades K-5 at the Julia P. Bryant School in Statesboro, Georgia. The total percentage improvement for all participating grade levels was 12.34% with some grade levels increasing by as much as 19%.

"I loved the games. The children caught on quickly and had so much fun. They didn't even realize they were learning."

Gail D. Tyson, Teacher
Julia P. Bryant School
Statesboro, GA



Cheyboygan School District (Cheyboygan, MI)

The following is statistical information for the entire Cheyboygan Area School District:

Schools: 7

Teachers: 132

Students: 2,246

Special Education Students: 231

College Bound Students: 59%

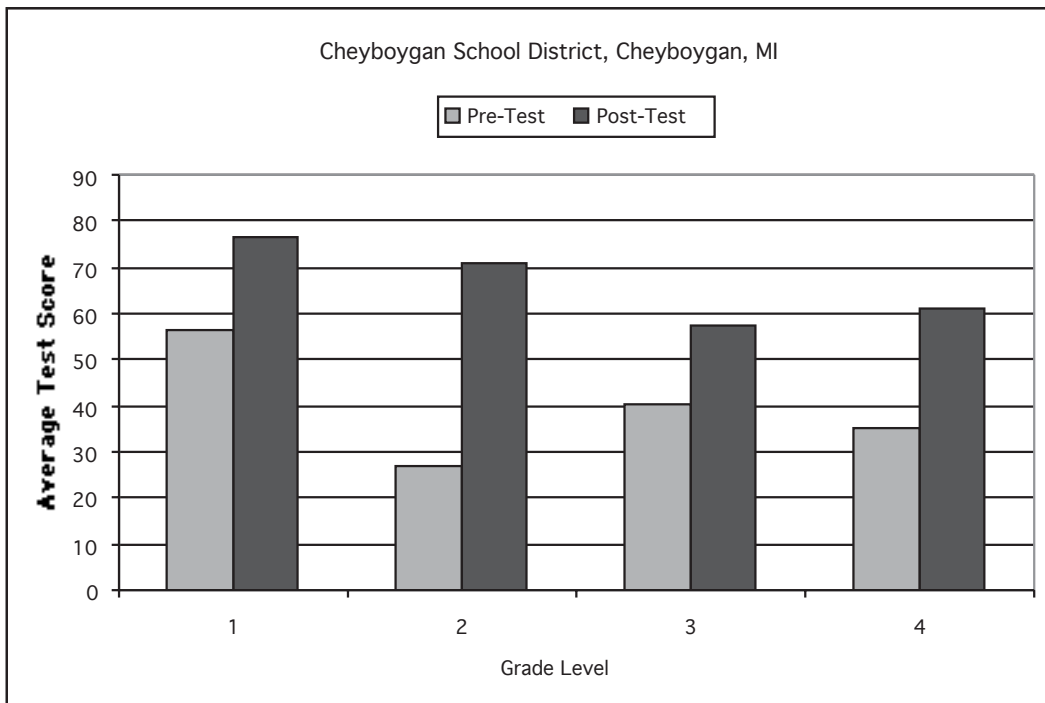
Ethnic: Asian 1%, African American 1%, Native American 3%, Caucasian 95%

Poverty: 19%

Cheyboygan Area School District used *Summer Success: Math* as the basis for their summer school program. Implemented in grades 1-4, the program helped overall posttest scores improve by 22.64%.

“This gave me new thoughts on my current methods and philosophies for teaching math, especially problem solving.”

Joey Miller, Teacher
Cheyboygan Area Schools
Cheyboygan, MI



Lowell Elementary (Lima, OH)

Lowell Elementary is part of the Lima City School District. The following statistical information is for the entire Lima City School District:

Schools: 12

Teachers: 369

Students: 5,326

Special Education Students: 926

College Bound Students: 68%

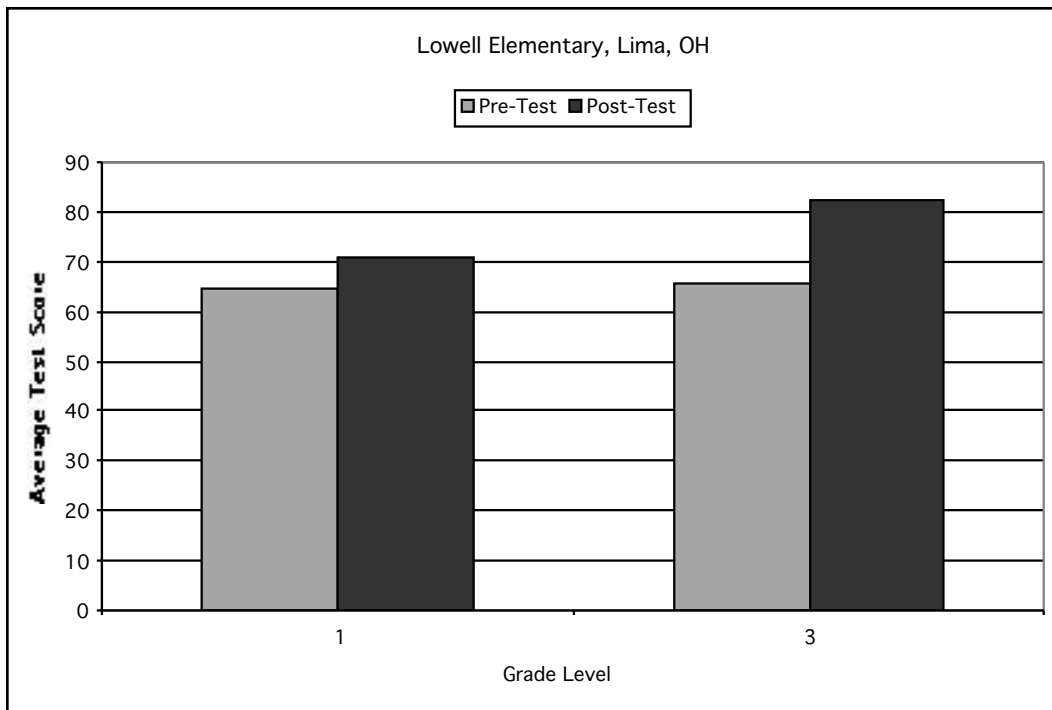
Ethnic: African American 42%, Hispanic 2%, Caucasian 56%

Poverty: 30%

Summer Success: Math was implemented for grades 1 and 3 at the Lowell Elementary School in Lima, OH. Posttest scores in grade 1 improved by over 6% while grade 3 scores increased by over 17%.

"I really enjoyed the [*Summer Success: Math*] program. With only an hour to devote to math each day, I felt the program was beneficial in teaching many topics."

Kathy Lovett, Teacher
Horace Mann Elementary
Lima, OH



North Bayou Elementary (Alexandria, LA)

North Bayou Elementary is part of the Rapides Parish School District. The following statistical information is for the entire Rapides Parish School District:

Schools: 53

Teachers: 1,535

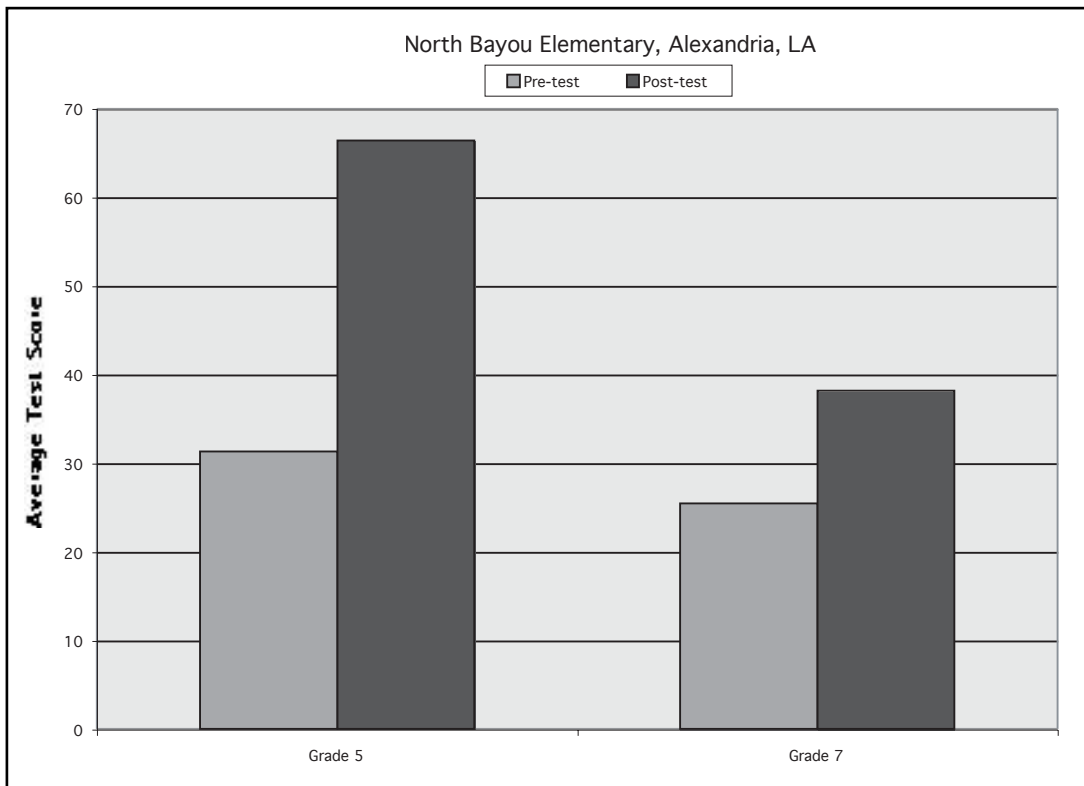
Students: 23,100

Special Education Students: 3,089

Ethnic: Asian 1%, African American 42%, Hispanic 1%, Native American 1%, Caucasian 55%

Poverty: 26%

Summer Success: Math was implemented for grades 5 and 7 at the North Bayou Elementary School.



Katy Independent School District (Katy, TX)

The following statistical information is for the entire Katy Independent School District:

Schools: 37

Teachers: 2,539

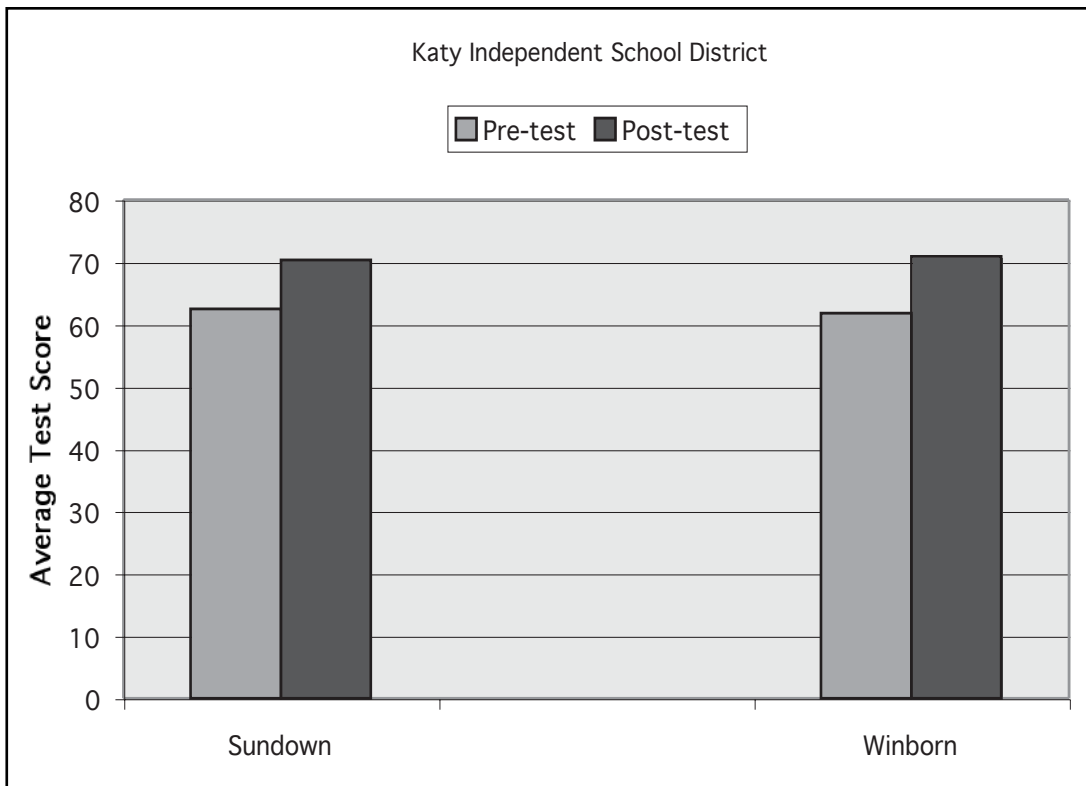
Students: 40,001

Special Education Students: 3,962

Ethnic: Asian 6%, African American 6%, Hispanic 18%, Caucasian 70%

Poverty: 5%

Summer Success: Math was implemented for grades 1–5 at two elementary schools in Katy, TX—Sundown Elementary School and Winborn Elementary School.



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Research Base and Program Efficacy



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