Pearson
Research Overview: Year 2

Scott Foresman•Addison Wesley

enVisionMATH™

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Pearson Research Overview

Pearson Education is committed to using scientific, evidence-based methods in the development of its educational curricula. A research team, comprised of educational research methodologists, has been working with Pearson for seven years to integrate scientific research practices into the development of its curricula. Pearson also collaborates with regional education laboratories, universities, and private research companies to independently evaluate the effectiveness and usability of its curricula. These studies are designed to meet the rigorous standards of the *What Works Clearinghouse*.

Four phases of research are incorporated into the development of each new curriculum. The goal of establishing such extensive research methods is to ensure that every program enables all children to learn the skills and concepts they need for academic success. During the first phase of the research process, previous editions of the curricula are evaluated to determine best instruction and practices as demonstrated by scientific evidence. These practices will be incorporated into the current curricula to begin establishing a scientific research base.

During the second phase the authors and researchers conduct extensive literature reviews on content, instructional practices, and education standards. The data is synthesized and embedded into the curricula.

During the third phase, formative research is conducted on the curricula under development. Classroom field tests investigate usability, teacher and student feedback, and preliminary curricula effectiveness. School administrators, content specialists, and classroom teachers systematically evaluate the curricula in development.

The final phase of research examines the implementation and effectiveness of the curricula. Independent, randomized control trial studies are conducted to provide scientific evidence of student achievement on standardized assessments. Implementation and best practices are documented throughout the study period to further contribute to the effectiveness of the curricula. Pearson believes that research needs to be ongoing with continual feedback to inform product revisions to meet student and teacher needs.

enVisionMATH™ Foundational Research

Pearson has used a variety of research methods as a base on which to build our *enVisionMATH*™ program. The precursor to *enVisionMATH* is the *Scott Foresman-Addison Wesley Mathematics (SFAW Mathematics)* program. *SFAW Mathematics* is a scientific, evidence-based program with empirical data that proves its effectiveness in increasing student math achievement. The *enVisionMATH* authors reviewed the scientific research studies supporting *SFAW Mathematics* to identify the best instructional practices and characteristics to incorporate into the *enVisionMATH* program. Some of the key findings from their review and an explanation of how these findings were incorporated into the 2009 *enVisionMATH* program are outlined below:

- Significant increase in classroom use of math games led to the development of two ready-made daily center activities.
- *SFAW Mathematics* programs led to significant improvement in students' communication of math, which translated into more opportunities for integrating math and language arts in the new program.
- The student understanding of math that improved through use of *SFAW Mathematics* translated to greater focus through daily conceptual development incorporating interactive, visual, and symbolic instruction in *enVisionMATH*.
- Manipulative use was highly rated and helped improve student engagement—therefore use was increased in *enVisionMATH*.
- Intervention and individualized instruction were enhanced and streamlined.
- The consistent, predictable lesson structure was augmented.

Please see the Pearson Web site (PearsonSchool.com) for a full description of the *SFAW Mathematics* foundation, efficacy studies, and a report that fully describes the components of *SFAW Mathematics* incorporated into *enVisionMATH*.

Formative research for 2009 *enVisionMATH* began in spring 2005 with the execution of a survey and focus groups. First, a lobby survey was administered to 86 teachers in the spring of 2005 throughout five locations in Pennsylvania, Texas, and California. The lobby survey elicited opinions about teachers' greatest challenges in teaching math, most important criteria, and current program/material usage. The results of this survey were used to prepare for upcoming focus groups. These focus groups were held in three locations in Pennsylvania and California for grades 1 and 4. In this first round of prototype testing, the *enVisionMATH* Student Edition (SE) and Teacher's Edition (TE) prototypes were reviewed, rated, and discussed by focus group participants. Their feedback was shared with editorial and authors to revise the prototypes to better meet teacher needs.

Following these focus groups, exploratory research into the Texas math market was conducted in April 2005. A total of four focus groups were held, two each in San Antonio, and a total of 36 first- and fourth-grade teachers participated. The purpose of these focus groups was to have teachers discuss the instructional process in its entirety by actually deconstructing the process. That is, they could focus more on the end results or outcomes teachers hope to achieve in the classroom rather than on the materials used. This feedback helped Pearson ensure the *enVisionMATH* program included the content and strategies to assist students in successfully achieving the critical outcomes identified by their teachers.

In November 2005, further focus groups were held in California, Illinois, New Jersey, and Texas for the purpose of eliciting feedback on various items, such as the Tables of Content organization, TE and SE packaging, and TE and SE prototypes. This additional feedback allowed the *enVisionMATH* team to further refine the prototype. Additionally in November 2005, math technology surveys and focus groups were done in California, Texas, and several other states and included more than 100 teachers at grades 1 and 4. The goal was to obtain insights into existing practices and future interest in computer resources for math instruction. This information was incorporated into the development of the digital path.

Field testing was then conducted to provide anecdotal feedback during the final stages of the development of *enVisionMATH*. Three teachers—two from grade 1 and one from grade 4—from Texas taught one topic using prototypes from the new math program. Feedback was provided in the forms of daily lesson logs, discussions with Pearson staff, and a post sample lesson testing survey. This feedback was used in the final revision to the *enVisionMATH* prototype before the program was published in 2007.

enVisionMATH Instructional Design

The 2011 *enVisionMATH* program is a research-based instructional model designed to make mathematics more accessible to a wide range of students. Through interactive learning and problem-based activities, students are able to build their own understanding of concepts and skills before the formal representation of ideas occurs.

Gagne and Driscoll (1988) found that the learning of skills typically requires the explicit prior development of simpler component skills (prerequisite skills). The use of the Daily Spiral Review sections ensures that students are accessing prior knowledge. The development of skills acquisition and conceptual understandings are an important component of *enVisionMATH*. Ball (2001) states that mathematics needs to be developed with a clear sense of the big mathematical ideas that support each of the skills students are expected to develop. In order to communicate clear lesson objectives, a Problem of the Day introduces each portion of the *enVisionMATH* lesson.

Visual representations drive concept and skill development and each lesson contains a student "visual learning band" which incorporates a dynamic presentation of the objective and essential understanding of the lesson. *enVisionMATH* author Stuart Murphy concludes, "Visual learning strategies can make a profound difference in a student's depth of understanding about mathematics" (Murphy, 1997, p. 5).

One example of a visual strategy incorporated into the program is using bar diagrams to solve word problems—problems that "too many students continue to be unsuccessful at solving!" (Charles, 1997, p. 1). Bar diagrams provide a visual representation to show how quantities are related in a word problem and help a student to see relationships and connect those to operation meanings (Charles, 1997). Indeed, Nickerson (1994) found that the ability to use bar diagrams is integral to mathematics thinking and learning.

Jitendra et al. (1999) found that each lesson should provide an adequate number of practice exercises on the new skill. Guided Practice and Independent Practice within each lesson provide ample practice for *enVisionMATH* users. Further, timely, frequent assessments throughout assist teachers in individualizing instruction, which is supported by the large range of differentiated instructional resources provided to teachers. Technology alternatives allow the print version to come alive through motion and sound. Teacher explanations and Center Activities reinforce, deepen, and extend learning.

The *enVisionMATH* program is organized into 20 individual content topics, rather than longer, broader chapters. Each topic contains from four to nine lessons and develops one or more related content standards in depth. *enVisionMATH* was developed so that all of the lessons in the program can be taught prior to the end-of-year state/district testing.

To accomplish the goals of the *enVisionMATH* program, resources were carefully designed to meet the needs of all students. Cognitive research on multiple intelligences (Gardner, 1991) indicates the need for children to experience a variety of pedagogical methods. *enVisionMATH* uses a variety of representations to help students understand mathematical concepts. Some of the ancillary materials included with the program and used by participating teachers include the following:

- Interactive Homework Workbook
- Interactive Math Series Big Book (K–2)
- Math Diagnosis and Intervention System
- Individual Student Manipulative Kits
- Teacher Overhead Manipulative Kits
- Center Activities Kits
- Visual Learning Bridge Transparencies
- MathStart readers by Stuart Murphy (K–2)
- World Scape readers (3–6)
- Exam*View*® Assessment Suite
- eTools

It should be noted that several built-in components of the *enVisionMATH* program, such as the Math Diagnosis and Intervention System (MDIS), are designed to aide teachers in providing intensive or Tier 3 intervention. The MDIS and other program tools help teachers provide individual instruction and intervention to students below level.

enVisionMATH Summative Research

Pearson strongly believes that its programs should be proven through scientific research to increase student achievement. As such, it contracted with independent research group PRES Associates, Inc., to conduct a longitudinal study of its *enVisionMATH* curriculum materials. The study commenced in 2007–08 with second- and fourth-grade students, following them into third and fifth grades in 2008–09. This report summary presents the evaluation design and methods, an assessment of program implementation, student performance results, and a discussion of findings.

Study Design and Research Questions

The purpose of this study was to evaluate and assess the effectiveness of the *enVisionMATH* curriculum in helping students attain critical math skills and to document the teachers' implementation of the *enVisionMATH* program. The study employed a longitudinal randomized, controlled trial (RCT) design with the random assignment of teachers to treatment and control groups. That is, teachers within each participating school were randomly assigned to use either *enVisionMATH* materials or their current school math curriculum. This study design was utilized in order to address all quality standards and criteria described in the What Works Clearinghouse (WWC) Study Review Standards (2008). Specifically, the study addressed the following overarching evaluation questions:

1. Do students in treatment groups demonstrate significant learning gains in math during the study period?
2. How does the math performance of students in treatment groups compare to that of students using other math programs?

3. How do teachers implement the *enVisionMATH* curriculum?

4. What are teachers' perceptions of the quality and utility of the *enVisionMATH* program?

Participants and Settings

PRES Associates recruited eight schools to participate in the first year of the study (2007–08), including sites in NH, MA, KY, TN, CO, MT, OH, and NC. Fifty-nine teachers and 1,197 students were represented from these states. Two schools (NC and CO) had to withdraw from the study during the second year (2008–09) to comply with district mathematics adoptions, prohibiting students from being randomly assigned to treatment or control conditions. Therefore, the final analytic sample was comprised of 44 teachers and 708 students. The study sample included representation of all ethnic, socioeconomic, special education status, and mathematical ability levels.

Measures

Multiple measures were used to assess student achievement and program implementation. In order to measure program implementation and teacher perceptions, evaluators collected data through observations and interviews with math teachers. Math teachers also completed monthly implementation logs. This background information provided researchers with a detailed data source on what was occurring in treatment and control classrooms in terms of math instruction and allowed researchers to identify areas of overlap in terms of content taught and activities. Evaluators also conducted biannual classroom observations and interviews with classroom teachers. The observation data provided critical insight into the nature of use and the effectiveness of the math materials used with treatment and control students.

Evaluators employed three student measures to assess changes in students' math skills over the course of the study. Teachers administered each assessment in fall 2007, spring 2008, and spring 2009. Evaluators selected the Metropolitan Achievement Test (MAT8) as a norm-referenced assessment of problem-solving and computation, the Group Mathematics Assessment and Diagnostic Evaluation (GMADE) – Concepts & Communication subtest of language and vocabulary, and the Balanced Assessment of Mathematics (BAM) as an open-ended, performance-based assessment. These assessments have broad visibility and acceptance in the field, demonstrate high technical merit, and align well with the *enVisionMATH* program. The assessments were given to all treatment and control students.

The MAT8 is a group-administered, norm-referenced test that assesses content and process skills that are relevant to students' everyday lives. The Math Computation, and Math Concepts and Problem-solving subtests were selected for administration. The Concepts and Problem-solving subtest measure a student's facility for applying mathematics to many different kinds of problems and evaluating his or her results. The Math Computation subtest measures students' ability to complete arithmetic operations.

The GMADE is a norm-referenced, standards-based assessment of mathematical skills. The Concepts and Communication subtest was selected for administration. This subtest uniquely addresses the language, vocabulary, and representations of mathematics. The MAT8 and GMADE tests were scored by PRES researchers following the standardized scoring procedures (including raw score conversions) as outlined in the publisher's technical/scoring manual.

Two versions of the BAM were used as part of this RCT—a published version for the 3rd, 4th, and 5th grades and one created for 2nd graders by PRES researchers. The assessments were designed as performance assessments in order to provide students with an opportunity to show what they know and understand. The BAM was scored by PRES researchers. In order to facilitate comparisons between the two tests, percent correct was the metric used for study analyses.

Additionally, teacher and student surveys were developed to gather information on attitudes that may be affected by their math program. Surveys were completed in the Fall and Spring of each year.

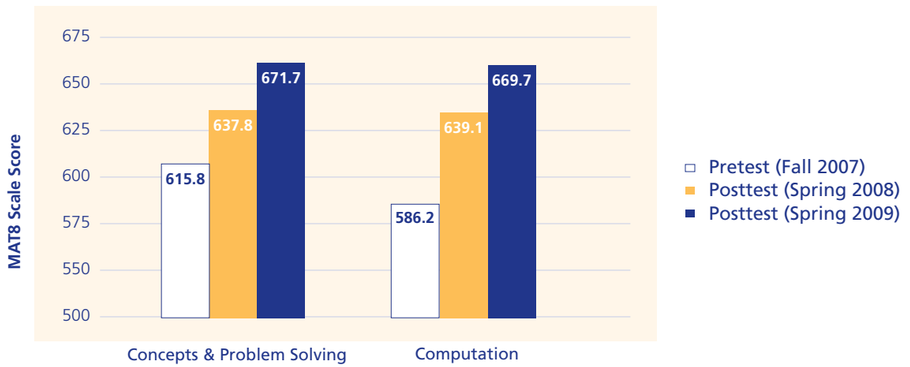
Student Performance Results

Results for enVisionMATH Students

PRES Associates determined that students who used *enVisionMATH* demonstrated statistically significant gains in math achievement over the two-year study period. Moreover, significant gains in achievement were evidenced after just one year of implementation as well. Specifically, students using *enVisionMATH* significantly improved in the areas of math concepts and problem-solving, math computation, math vocabulary, and communication in math.

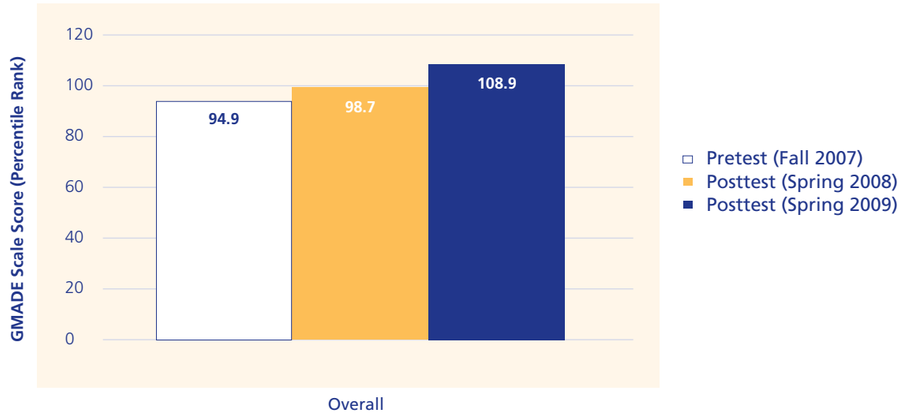
The results also provided evidence of accelerated growth rates during the second year of *enVisionMATH* usage in the areas of math concepts and problem-solving, and math vocabulary skills. This suggests the cumulative effects of *enVisionMATH* become stronger over time.

Figure 1—*enVisionMATH* Students' Math Performance at Pre- and Posttesting: Metropolitan Achievement Test (MAT8) which tests understanding of math concepts and problem solving.



There was significant improvement in *enVisionMATH* students' understanding of math concepts and problem-solving and math computational skills.

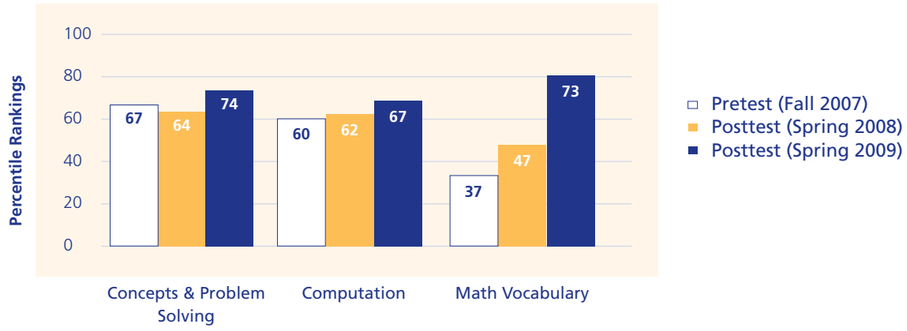
Figure 2—*enVisionMATH* Students' Math Performance at Pre- and Posttesting: GMADE, which focuses on math vocabulary.



enVisionMATH students also showed significant gains in math vocabulary (GMADE).

Learning gains experienced by *enVisionMATH* students can also be seen in growth of *percentile ranks*[1] from the norm-based assessments. It is a general rule of thumb that if a student makes a year's growth for a year of instruction, then the percentile rank will remain the same. As shown in Figure 3, the percentile rank grew more than would be expected in a typical academic year for concepts and problem-solving, computation, and math vocabulary.

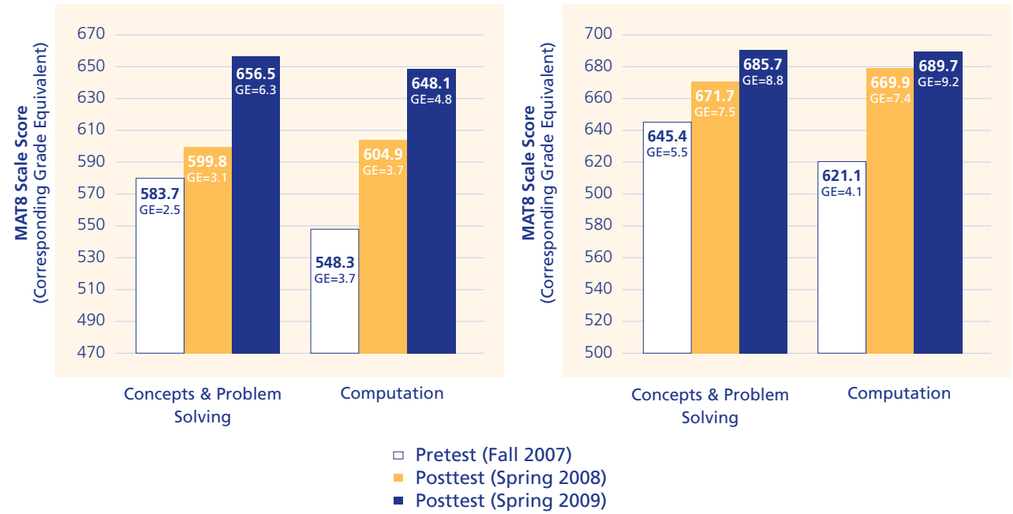
Figure 3—*enVisionMATH* Students' Percentile Rankings at Pre- and Posttesting



It is also useful to examine learning gains of *enVisionMATH* students as evidenced by grade equivalents. The 2nd to 3rd grade cohort of students saw gains of 3.8 grade equivalents in concepts and problem-solving, and 2.5 grade equivalents in computation. The 4th to 5th grade cohort of students saw gains of 3.3 grade equivalents in concepts and problem-solving, and 5.1 grade equivalents in computation. The average growth expected per year is 1 grade equivalent.

[1]Percentile ranks indicate the percentage of students in the same grade in the norm (reference) groups who took the test at a comparable time and whose scores fall below a student's score. Since percentile ranks do not represents equal units, and since their interpretation is limited to the reference group from which they were derived, they are best used for reporting scores when position in relation to the reference group is of primary interest.

Figure 4—*enVisionMATH* Study Performance at Pre- and Posttesting for 2nd to 3rd grade (left) and 4th to 5th grade (right): MAT8



Subgroup Results: enVisionMATH Students

Evaluators found that the *enVisionMATH* program worked just as well with 2nd–3rd, and 4th–5th graders, females and males, white and non-white students, special education and non-special education students, students receiving free/reduced lunch and those not receiving this aid, and students at various math levels. A greater rate of improvement was demonstrated for certain subgroups of *enVisionMATH* students, including special education, free/reduced lunch eligible, low math ability, and high math ability students. However, *enVisionMATH* students in all subpopulations showed significant learning gains on all assessment measures.

enVisionMATH vs. Other Math Programs

Evaluators conducted analyses comparing how *enVisionMATH* students performed in comparison to students using other math programs. Results showed positive effects of the *enVisionMATH* program. Elementary students who used *enVisionMATH* over a two-year period showed greater gains in math computation, math problem-solving and communication, and math communication as compared to students who used other math programs. These results can be seen in Figures 4–7.

The gains exhibited by *enVisionMATH* students as compared to students using other math programs were also noteworthy because the effect sizes obtained were higher than those observed during the first year of the study. The effect sizes for the *enVisionMATH* program on student math performance ranged from .25 to .46. These effect sizes are higher than those from the first year of the study (.20 to .24), suggesting that stronger effects were evident as students and teachers had more experience with *enVisionMATH*. Furthermore, last year there were significant differences on the MAT8 Computation (d=.21), GMADE (d=.24), and BAM (d=.20), also in favor of *enVisionMATH*. With the exception of the GMADE subtest, the consistency in positive effects obtained for the *enVisionMATH* program over the course of two years lends support to the conclusion that the *enVisionMATH* program has a positive impact on student performance.

Figure 5—Pre- and Posttest MAT8 Concepts and Problem Solving for *enVisionMATH* and Students Using Other Math Programs

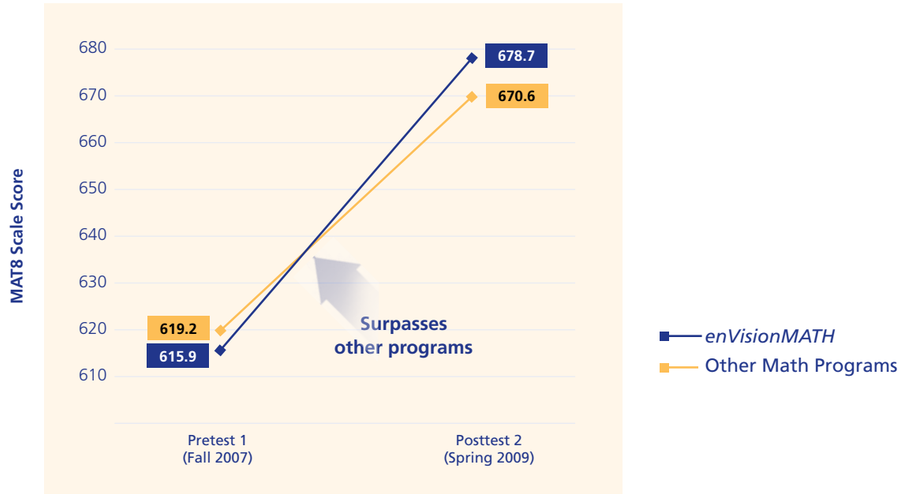


Figure 6—Pre- and Posttest MAT8 Computation for *enVisionMATH* and Students Using Other Math Programs

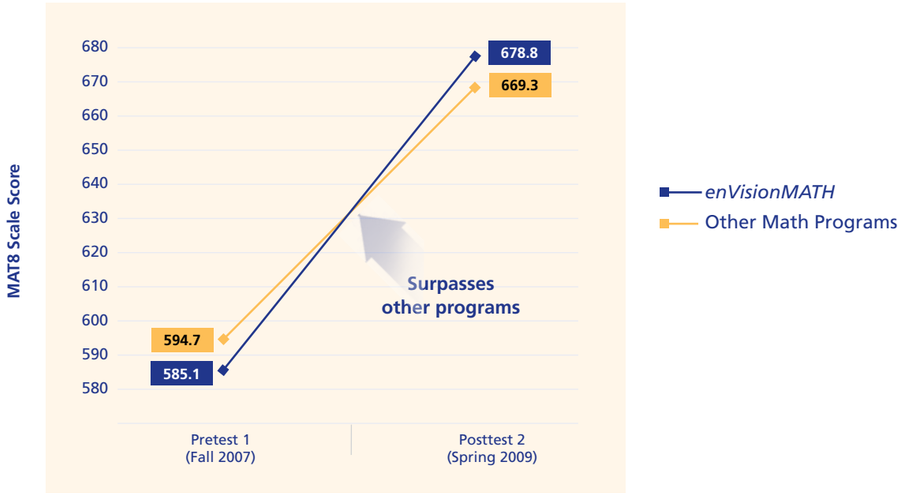
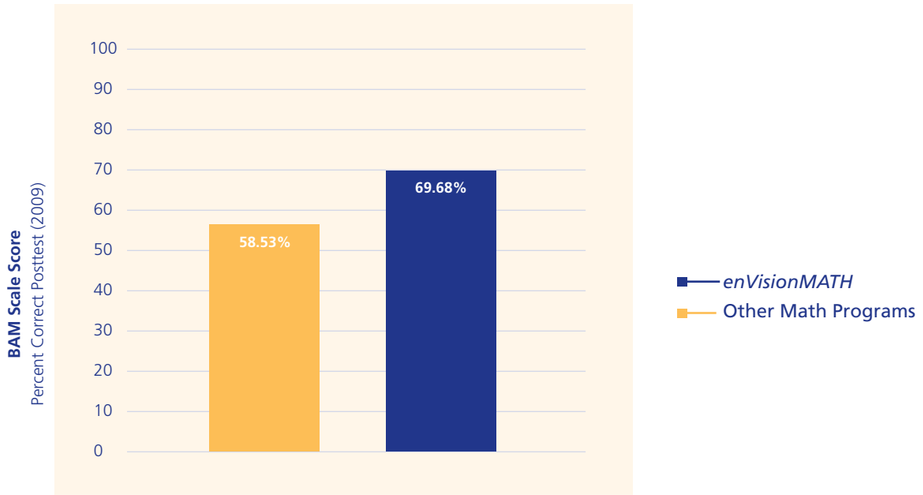


Figure 7—Posttest BAM for *enVisionMATH* and Students Using Other Math Programs



Note that only comparison of posttest results for the BAM can be used for purposes of the outcomes analysis. The BAM is not vertically scaled, and results are not comparable on the same scale across different grade levels. Consequently, only a comparison among Spring 2009 results is presented.

Subgroup Results: enVisionMATH vs. Other Math Programs

Evaluators also analyzed subgroup differences between *enVisionMATH* and other math programs. Results showed a significant difference between *enVisionMATH* students and students using other math programs in the following subgroups: 3rd graders and females. Specifically, *enVisionMATH* students who were females showed greater gains on the MAT8 Math Computation and GMADE tests as compared to students using other math programs, t-ratio=14.06, p=0.03 and t-ratio=6.79, p=0.04. Program effects were also found for third-grade students on the MAT8 Math Computation in that the *enVisionMATH* program had a more positive impact on 3rd graders as compared to other math programs, t-ratio=12.78, p=0.03.

> *"The program is very engaging and the kids love it."*
>
> —Second-grade *enVisionMATH* teacher

Results by Type of Control Program

In addition, the positive effects obtained on the *enVisionMATH* program were observed across a number of different schools who used a variety of types of control programs. Specifically, *enVisionMATH* students performed significantly better than students using other math programs that were purely investigative and inquiry-based, as well as students who used more traditional basal math programs during the first year of the study. During the second year of the study, 5 of the 6 schools used basal math programs. The students using

enVisionMATH performed significantly better than students using other traditional basal math programs in the area of math computation. In the one school that used a purely inquiry-based program as their control curriculum, the *enVisionMATH* students significantly outperformed control students in the area of math vocabulary. Such findings are comparable to what was found during Year 1 of the randomized control trial during which positive program effects were also found in favor of *enVisionMATH* as compared to both basal and inquiry-based programs.

Student Attitudes

In addition to providing evidence of efficacy, PRES Associates investigated other outcomes associated with use of the *enVisionMATH* program. The full results of the report, *A Study on the Effects of Pearson's 2009* enVisionMATH *Program,* are available on the Pearson Education (www.pearsoned.com) Web site.

Results from student surveys of math-related attitudes showed that *enVisionMATH* students enjoyed math more than students using other math programs and perceived math to be more important. In addition, interviews with *enVisionMATH* teachers substantiated these findings as several teachers explicitly mentioned they felt their students like math more as a result of using the *enVisionMATH* program.

> *"The students grasp the materials better, they're better at problem-solving, and their questions are higher order."*
>
> —Third-grade *enVisionMATH* teacher

Teacher Perceptions of enVisionMATH

Consistent with the findings from 2nd- and 4th-grade teachers during year 1 of the study, 3rd- and 5th-grade teachers felt that the *enVisionMATH* program was effective in teaching their students math. Teachers felt the program contributed positively to students being able to express what they were thinking and explain how they arrived at answers. In addition, all *enVisionMATH* teachers agreed that their students were academically challenged by the program in comparison to 70% of control teachers. This finding was particularly interesting as the actual student performance results indicated *enVisionMATH* students saw significantly greater gains in problem-solving and concepts, computation, and communication. In addition, 95% of treatment teachers reported being satisfied with the progress of their students and that students were clearly learning math.

> *"*enVisionMATH *is an excellent math program. This is the first real change that I've seen in math instruction since I was a student in elementary school."*
>
> —Fifth-grade *enVisionMATH* teacher

enVisionMATH teachers also consistently commented on the improvement in math vocabulary and writing. As a result of the emphasis placed on reading and writing in math, *enVisionMATH* teachers felt their students reading and writing skills improved more than the students using other math programs.

> *"The program leads to good inquiry questions for students and is logical; reading skills affect math skills; this is the future—*enVisionMATH."
>
> —Fifth-grade *enVisionMATH* teacher

Conclusion

The breadth and depth of research that supports this program proves that *enVisionMATH* is truly a scientific, evidence-based program with empirical data to prove its effectiveness in increasing student math achievement. In addition, independent evaluators found that *enVisionMATH* students statistically outperformed students using other math programs in the areas of math problem-solving and concepts, computation, and communication. Teachers and students using *enVisionMATH* reported satisfaction with the program. In sum, scientific research indicates that the *enVisionMATH* program is an effective and useful program for both teachers and students.

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Notes