Pearson
Research Overview

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 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 for 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 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 grade 1 and one grade 4 teacher 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 2009 *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 both 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 expects 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 allowed 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 a few 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:

- 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 reaching all learners. The MDIS and other program tools help teachers provide individual instruction and remediation to students below level.

enVisionMATH Summative Research

Pearson strongly believes that its products must demonstrate proven effectiveness in increasing student learning. As such, it contracted with PRES Associates, Inc., an external, independent consulting firm specializing in educational evaluation, to conduct an independent study of its *enVisionMATH* curriculum materials. PRES Associates conducted this study for Pearson during the 2007–2008 school year. This report summary presents the study design and participants, student performance results, an assessment of program implementation, impact on student attitudes, and a discussion of findings.

Study Design and Research Questions

The purpose of this study was to evaluate the teachers' implementation of the *enVisionMATH* program and to assess the effectiveness of the materials in helping students attain critical math skills. The evaluation study employed a randomized controlled trial (RCT) design with the random assignment of teachers to treatment and control groups. That is, teachers within a school were randomly selected to participate using either *enVisionMATH* materials or their typical math curriculum. This study design was utilized in order to meet all of the *What Works Clearinghouse (WWC)* design requirements without reservations. Specifically, the study addressed the following overarching evaluation questions:

1. Do students in *enVisionMATH* groups demonstrate significant learning gains in math during the study period?

2. How does the math performance of students in *enVisionMATH* groups compare to groups 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?

PRES Associates recruited eight schools to participate in this study, including sites in Colorado, Kentucky, Maine, Montana, New Hampshire, North Carolina, Ohio, and Tennesse. A total of 1,197 students and 59 teachers participated in the study. The study sample included representation of all ethnic, socioeconomic, special education status, and mathematical ability groups.

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 completed monthly implementation logs. Such 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 classroom observations and interviews with classroom teachers. These 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 during the 2007–2008 school year. Teachers administered the assessments at the beginning of the year and at the end of the year. Evaluators selected the *Metropolitan Achievement Test (MAT8)* as a norm-referenced assessment, the Group Mathematics Assessment and Diagnostic Evaluation *(GMADE)—Concepts & Communication* subtest: as a language and vocabulary assessment, and the *Balanced Assessment of Mathematics (BAM)* as an open-ended, performance-based component. 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 the Math Concepts and Problem-solving subtests were selected for administration. The Concepts and Problem-solving subtest measures a student's facility for applying mathematics to many different kinds of problems and evaluating their results. The Math Computation subtest measures students' ability to complete arithmetic operations.

GMADE, published by Pearson Assessment, 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 fourth grade and one created for second graders by PRES researchers. Both assessments are 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 in the present study.

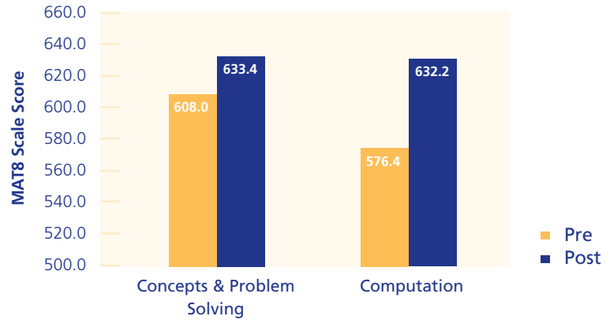
Additionally, teacher and student surveys were developed to gather information on attitudes that may be affected by their math program. Surveys were completed in the Fall and Spring.

Student Performance Results

Results for *enVisionMATH* Students

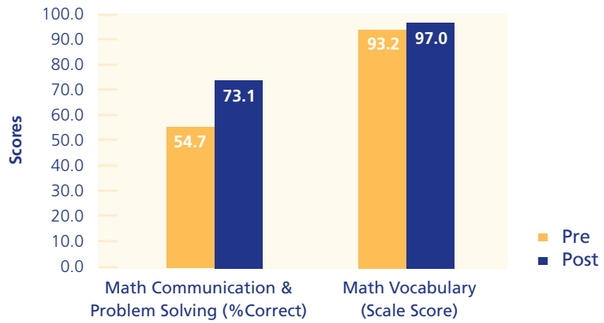
PRES Associates determined that students who used *enVisionMATH* demonstrated statistically significant gains in math achievement during the one-year study period. Specifically, students using *enVisionMATH* significantly improved in the areas of math concepts and problem-solving, math computation, math vocabulary, and communication in math.

Figure 1 — *enVisionMATH* Students' Math Performance at Pre- and Posttesting: Metropolitan Achievement Test (MAT8)



There was significant improvement in *enVisionMATH* students' understanding of math concepts and problem-solving and math computational skills. In these areas, students showed percentile gains of 19 and 33 points respectively.

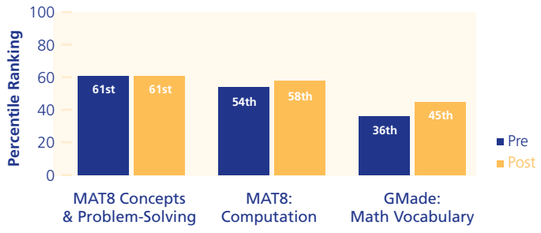
Figure 2 — *enVisionMATH* Students' Math Performance at Pre- and Posttesting: GMADE and Balanced Assessment in Math (BAM)



enVisionMATH students also showed significant gains in math communication and problem-solving (BAM) and in math vocabulary (GMADE). In these areas, *enVisionMATH* students showed percentile gains of 36 and 15 points respectively.

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 math computation and math vocabulary. On the MAT8 Concepts and Problem-solving subtest, *enVisionMATH*™ students showed a typical amount of growth (i.e., equivalent to one year of instruction).

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



"A lot of students who did not have good math skills in the beginning have seen some nice gains."

Second grade *enVisionMATH* teacher

[1]Percentile ranks indicate the percent 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.

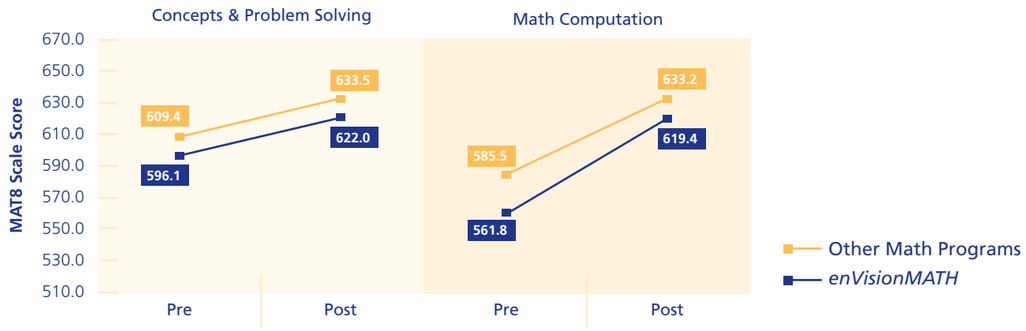
Subgroup Results: *enVisionMATH* Students

Evaluators found that the *enVisionMATH* program worked just as well with second and fourth 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. Although a greater rate of improvement was demonstrated for certain subgroups of students, *enVisionMATH* students in all subpopulations showed significant learning gains on all assessment measures.

enVisionMATH vs. Other Math Programs

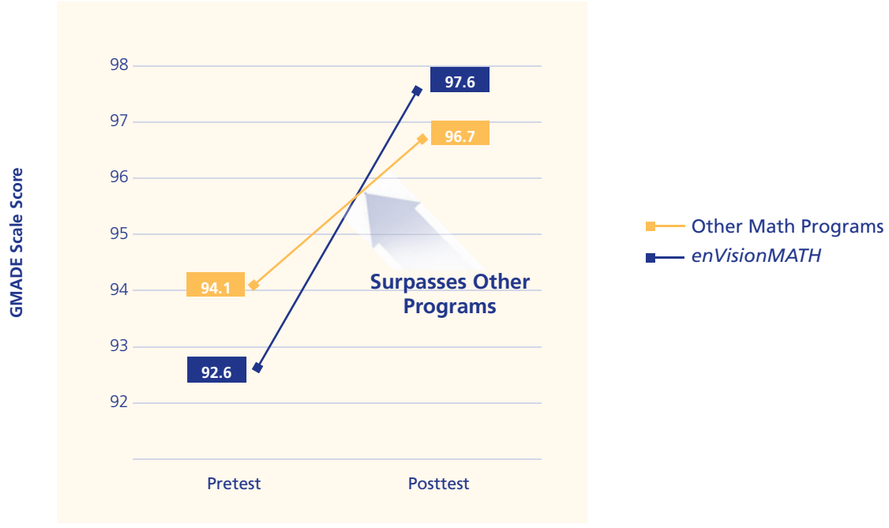
Evaluators conducted analyses comparing how *enVisionMATH* students performed in comparison to students using other math programs. Results showed positive effects of the *enVisionMATH* program. Elementary students who used *enVisionMATH* in 2007–08 showed greater gains in math computation, math vocabulary, and math problem-solving and communication as compared to students who used other math programs. These results can be seen in Figures 4–6.

Figure 4 — Pre- and Posttest MAT8 for *enVisionMATH* and students using other Math Programs



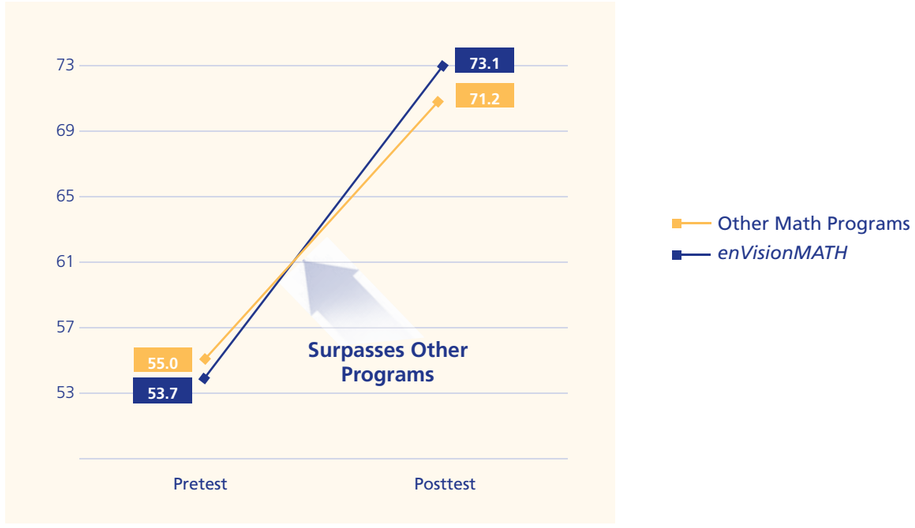
Growth analyses showed signifiicntly greater gaims on math computation (i.e., the blue line's slope is steeper). This means that *enVisionMATH* students showed greater rates of growth in math computation performance from pre- to post-testing as compared to control students.

Figure 5 — Pre- and Posttest GMADE Math Performance of *enVisionMATH* and Students Using Other Math Programs



On the GMADE, a measure of math vocabulary understanding, *enVisionMATH* students showed significantly more improvement than students using other math programs. Note that while *enVisionMATH* students showed lower performance at pre-testing (though not significantly so), they subsequently surpassed the students using other math programs by the end of the school year.

Figure 6 — Pre- and Posttest BAM Performance of *enVisionMATH* and Students Using Other Math Programs



enVisionMATH students showed significantly greater gains in math problem-solving and communication as compared to students using other math programs. Although *enVisionMATH* students showed lower performance at pre-testing (though not significantly so), they subsequently surpassed students using other math programs and showed higher test scores at post-testing.

Subgroup Results: *enVisionMATH* vs. Other Math Programs

Evaluators also analyzed subgroup differences between *enVisionMATH* and students using other math programs. Results showed a significant difference between *enVisionMATH* students and students using other math programs in the following subgroups: fourth grade and females. Specifically, females and fourth grade *enVisionMATH* students showed greater math gains on the MAT8 Math Computation, t-ratio=10.16, p=0.02 and t-ratio=17.66,p=0.03, and BAM tests, t-ratio=3.25, p=0.01 and t-ratio=3.22, p=0.05, as compared to control students. This suggests that the *enVisionMATH* program has a more positive impact on the computational, and math problem-solving and communication skills of females and fourth graders as compared to other math programs. Significant differences were also observed among high math ability students. Results showed that high level math students who used *enVisionMATH* demonstrated greater improvement in math vocabulary as measured by the GMADE as compared to high math level control students, t-ratio=3.27, p=0.03.

Results by Type of Other Math Programs

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 control students who used programs that were purely investigative and inquiry-based as well as students who used more traditional basal math programs. This consistency in findings across different curricula, schools, and measures lends credence to the conclusion that *enVisionMATH* positively impacts student math knowledge and skills.

> *"A lot of information is covered in each lesson...and it makes the students think and apply the information in order to problem solve."*
>
> Fourth grade *enVisionMATH* teacher

enVisionMATH Implementation

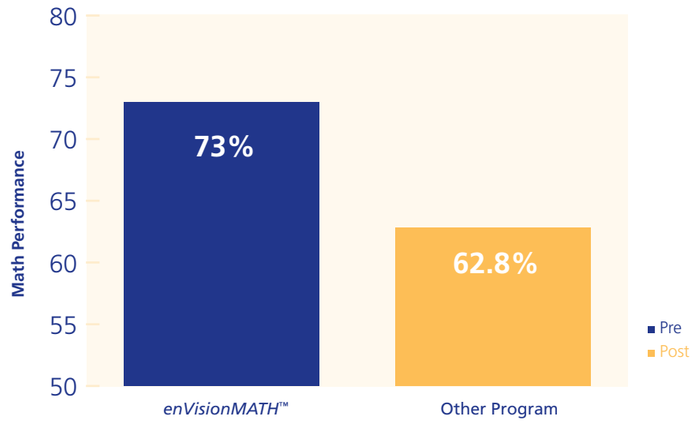
In addition to providing evidence of efficacy, PRES Associates investigated other outcomes associated with use of the *enVisionMATH* program. The full results of the report *A Study on the Effects of Pearson's 2009 enVisionMATH™ Program: 2007-08 First Year Report* are available on the Pearson Web site.

Exploratory analyses on the relationship between overall levels of *enVisionMATH* implementation and student posttest performance showed a significant relationship between overall *enVisionMATH* implementation levels and improved performance on the outcome measures. Specifically, students whose teachers used the *enVisionMATH* program with high fidelity showed an average of sixteen more points on the MAT8 Concepts and Problem—solving subtest (2.7% gain) and three more points on the GMADE (3.3% gain)

Student Attitudes

Results showed that *enVisionMATH* students enjoyed math more than control students. Indeed, 73% of *enVisionMATH* students noted that they liked the program used in math class as compared to 62.8% of control students.

Figure 7 — Student enjoyment using *enVisionMATH* versus other programs



"The program is very engaging and the kids love it."

Second grade *enVisionMATH* teacher

Additionally, *enVisionMATH* students perceived greater teacher support as compared to control students (82% vs. 75%, Treatment vs. Control, respectively: $p < .05$).

Positive results were also observed with regard to student perceptions of the extent to which the *enVisionMATH* program helped them to learn math. Eighty-six percent of *enVisionMATH* students agreed that the homework assigned in their math class helped them to learn versus 79% of control students. Moreover, 73% agreed that the pictures in their math book helped them to understand how to do math problems compared to 58% of control students (p-values < .05).

"[The program] is more visual to them. [Students] can pull the numbers apart. They have a better number sense. They can actually see them."

Fourth grade *enVisionMATH* teacher

Teacher Perceptions of *enVisionMATH*

Results showed *enVisionMATH* teachers were more prepared to carry out various mathematics activities, and in fact, tended to engage in a greater variety of mathematics activities and strategies as compared to control teachers.

*"[Pearson] has done really well with this series. I am very pleased with **enVisionMATH**. I have enjoyed teaching math using these materials very much."*

Second grade *enVisionMATH* teacher

Teachers also felt that the *enVisionMATH* program was effective in teaching their students math. For instance, 93% of *enVisionMATH* teachers agreed that their students were clearly learning math, and 74% indicated satisfaction with student progress. Additionally, 85% of teachers agreed that their students were academically challenged by the program, compared to only 62% of control teachers (p-values < .05).

"I love it. I can see where it helps the children to have the higher level thinking skills."

Second grade *enVisionMATH* teacher

Overall, teachers indicated that the assessments provided with the *enVisionMATH* program were useful. A higher percentage of *enVisionMATH* teachers (88.9%) indicated that the informal assessments provided with the program were useful as compared to only 44% of control teachers ($p < .05$).

enVisionMATH teachers noted that the remediation and enrichment resources were useful in differentiating instruction (68% of treatment teachers vs. 48% control teachers, $p < .05$).

"Educators need to focus on designing activities that build upon a variety of students' resources in order to support academic success.…Hence regardless of their level of English-language proficiency or mathematical knowledge, all students are competent and resourceful mathematical language learners."

Verónica Galván Carlan, *enVision*MATH author (Galván Carlan, V., p. 3)

"I think it's great for all ability levels, especially with LEP and I think it's great for all students. With my low performing it gives the visuals, for my LEPs it gives those visuals plus the definition cards…With my high level they have that enrichment."

Fourth grade *enVisionMATH* teacher

Discussion

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 computation, math vocabulary, and math problem solving and communication. Further analyses revealed that *enVisionMATH* had a more positive impact on the computational, and math problem-solving and communication skills of females and fourth graders as compared to other math programs. 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