Pearson
Research Overview

Prentice Hall
MATHEMATICS

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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 eight 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. Pearson established such extensive research methods 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 instructional practices as demonstrated by scientific evidence. These practices will be incorporated into the new 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 for synthesis into revised and future curricula, further contributing to their effectiveness. Pearson believes that research needs to be ongoing with continual feedback to inform product revisions to meet student and teacher needs

Pearson Prentice Hall Middle Grades Mathematics Foundational Research

The *Pearson Prentice Hall Middle Grades Mathematics (Prentice Hall Middle Grades Math)* program is a comprehensive middle school math curriculum. Emphasizing algebraic reasoning, the program is based on "research that describes how students learn mathematics well and provides classroom-based evidence of program efficacy."[1] The authors focused on building the skills and understanding of all students. The *Prentice Hall Middle Grades Math* curriculum uses an instructional design that provides a consistent lesson structure, develops both skills and understanding, and gives ample examples and leveled practice. *Prentice Hall Middle Grades Math* provides effective learning activities and questioning strategies, consistent review within instruction, and embeds ongoing assessment. The text is aligned to the National Council of Teaching Mathematics (NCTM) Standards [2] and is organized around the objectives identified in the National Assessment of Education Progress 2005 Assessment Specifications.[3]

The authors of *Prentice Hall Middle Grades Math* have vast experience in mathematics and mathematics education. The series author, Randall I. Charles, Ph.D., is Professor Emeritus in the Department of Mathematics and Computer Science at San Jose State University. He began his career as a high school mathematics teacher and has been a member of several NCTM committees. In addition to Dr. Charles, other program authors bring expertise from classrooms, school-based and district-wide administration, research and policy development, and writing.

In developing *Prentice Hall Middle Grades Math*, four critical program areas were identified: instructional design, problem solving, meeting individual needs, and approaches to important content. Each of these areas carries a strong research base that was incorporated in the development of *Prentice Hall Middle Grades Math*.

Instructional design refers to the structure of a lesson as presented in the student textbook. In building the instructional design of *Prentice Hall Middle Grades Math*, authors emphasized; consistent lesson structure, development of both skills and conceptual understandings, effective learning activities and questioning strategies, and embedded, ongoing assessment.

Jitendra et al. (1999), in examining the instructional design of seven mathematics programs, found that all learners, but particularly special-needs learners, are aided when lessons are built around a consistent structure. *Prentice Hall Middle Grades Math* communicates both procedural and conceptual objectives to students and teachers. Lessons begin with a section that assesses prior knowledge necessary for the new lesson. *Prentice Hall Middle Grades Math* incorporates multiple examples broken into clear and meaningful steps and addresses the key variations of the newly introduced skills, including real-world applications of the skills. Research indicates each lesson should provide a sufficient amount of examples to students for practice prior to students independently practicing the new skill.

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[1] Detailed information on this scientific research base can be found in the following document: Pearson Education (2004). *Putting Research Into Practice:* An Overview of the Scientific Research Base of Prentice Hall Mathematics. Upper Saddle River, NJ: Prentice Hall. Online: *http://www.phschool.com/Research/math*.

[2]National Council of Teachers Mathematics (2002). *Principles and Standards for School Mathematics*. Reston, Virginia: NCTM.

[3]National Assessment Governing Board – U.S. Department of Education (2004). Mathematics Framework for the (Washington, DC: Author) Online: *http://www.nagb.org/pubs/m_framework_05/toc.html*

Sufficient practice of important skills and ideas has long been accepted as an important component of effective instruction. The development of both skill acquisition and conceptual understanding is a cornerstone of *Prentice Hall Middle Grades Math*. The curricula builds appropriate, leveled practice into every lesson by focusing on both the skills and concepts developed in that lesson. Kloosterman and Gainey (1993) state: "Students who can connect mathematical procedures with underlying concepts are likely to apply those procedures rather than in an arbitrary, inappropriate fashion." The examples in *Prentice Hall Middle Grades Math* provide step-by-step development of concepts and skills. Each step is consistently justified or explained so students understand the "why" behind mathematics. The connection between skills and conceptual understanding is enhanced by showing students that there is often more than one way to think about how to apply skills to a problem.

The authors of *Prentice Hall Middle Grades Math* have incorporated numerous opportunities for students to interact with subject matter and to reflect on the ideas that they are learning. Wood and Turner-Vorbeck (2001) argue that it is critical that students be involved in the lessons, listen to each other, and engage in a variety of interactions with the materials being studied. Investigations involving manipulative materials are included both prior to and within lesson to encourage students to work together to explore rich mathematical contexts. Hiebert et al. (1997) indicated questioning increases student-to-student interaction so that students' ideas, expressed in their terminology, are shared with the class. Questioning is a driving force to both engage students and offer ongoing assessment data for the teacher in *Prentice Hall Middle Grades Math*.

Research evidence suggests that in middle grades mathematics, it is particularly important that assessment practices are ongoing and integrated into the fabric of the daily classroom routine. *Prentice Hall Middle Grades Math* is designed so that student readiness and understanding are continually evaluated through a seamless process of assessment, diagnosis, and intervention that makes it possible for teachers to use real-time data to meet the needs of individual students. Due to lacking space to adequately address all aspects of research-base, a separate document, Prentice Hall Mathematics *Putting Research Into Practice: An Overview of the Scientific Research Base of Prentice Hall Mathematics*, was created by Pearson and program authors to illustrate the connections between the research base and program features. This document is available upon request from Pearson.

Once the scientific research base of *Prentice Hall Middle Grades Math* was established, Pearson began formative research on the program. An exploratory needs assessment was administered to a sample of middle school math teachers to determine what was important to them in a math curriculum, their greatest challenges in teaching math, and the most important features of their current math curricula. In addition, surveys were periodically sent to a larger sample of middle school math teachers to continually receive feedback on curriculum issues and challenges. Pearson also hosted focus groups and conference calls with teachers and advisory panels to provide feedback on specific program features, such as the table of contents. Quantitative and qualitative data was collected via classroom observations and conference participation to explore needs of students, teachers, and other educators regarding each Chapter of Middle Grades Math Course 2.

Once a prototype was developed, prototype materials from each chapter of the *Prentice Hall Middle Grades Math* program were field-tested with students and teachers. Qualitative and quantitative feedback from students, teachers, and supervisors were collected and used for revisions and continuous program improvement. Educator advisory panels also provided feedback on program development as well as guidance on integrating the most successful components of the previous *Prentice Hall Math* program copyrights into this edition. At the conclusion of this research, the final *Prentice Hall Middle Grades Math* program was published.

Pearson Prentice Hall Middle Grades Mathematics Summative Research

Pearson strongly believes that its products must demonstrate proven effectiveness in increasing student learning. As such, it contracted with PRES Associates, an independent consulting firm specializing in educational evaluation, to conduct a study of its *Prentice Hall Middle Grades Math* program. 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 the teachers' implementation of the *Prentice Hall Middle Grades Math* 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 assigned to either the *Prentice Hall Middle Grades Math* 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. Does math ability improve over the course of participating in *Prentice Hall Middle Grades Math*? Does this vary by different types of students and levels of implementation?
2. How does mathematics performance differ between students who use *Prentice Hall Middle Grades Math* as compared to students using other math programs?
3. Does participation in *Prentice Hall Middle Grades Math* result in other positive student outcomes (e.g., positive attitudes towards math, etc.)?

Participants and Settings

PRES Associates recruited five schools to participate in this study, including sites in CO, FL, KY, MI, and NY. A total of 922 students and 15 teachers participated in the study. The sample was ethnically diverse and represented schools in urban, suburban, and rural settings. Table 1 presents full demographic information for the study sample, broken out by treatment and control condition.

Table 1 – Student Demographics by Site

School	School Size	Ethnic Breakdown	% Special Education	% Limited English Proficiency	% Free/ Reduced Lunch	Gender Breakdown
Michigan	365	5.1% White 3.8% Hispanic 91.1% African Am. 0% Other	12.7%	3.8%	97.5%	44.3% Male 55.7% Female
New York	107	2.4% White 89.3% Hispanic 7.8% African Am. 6.9% Other	19.5%	11.7%	100.0%	49.3% Male 50.7% Female
Florida	724	73.7% White 2.6% Hispanc 15.8% African Am. 7.9% Other	5.1%	1.3%	50.6%	46.8% Male 53.2% Female
Colorado	1150	59.2% White 18.8% Hispanic 15% African Am. 0% Other	7.1%	3.5%	NR	45.5% Male 54.4% Female
Kentucky	707	46.5% White 22.9% Hispanic 27.5% African Am. 3.1% Other	7.5%	0.0%	39.3%	55.2% Male 44.8% Female

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. Evaluators also utilized student and teacher surveys to examine attitudes about school, enjoyment of math, math effort and motivation, classroom practices, attitudes about math curriculum, etc. The data provided critical insight into the nature of use and the effectiveness of the math materials used with the treatment and control students.

Evaluators employed three student measures to assess changes in students' math skills during the 2007–2008 school year. Evaluators selected the *Iowa Test of Basic Skills (ITBS)*, the Group *Mathematics Assessment and Diagnostic Evaluation (GMADE)* subtest of Concepts and Communication, and the Balanced Assessment of Mathematics (BAM). The BAM added an open-ended, performance-based component. These assessments have broad visibility and acceptance in the field and demonstrate high technical merit. These assessments were given to all treatment and control students.

The *ITBS*-Level 13 Form A test is a national, norm-referenced test developed by Riverside Publishing. It consists of multiple-choice items designed to address multiple math content areas typically taught at the 7th grade. Validity and reliability provided by Riverside demonstrate the test accurately measures a range of performance levels typically shown at this grade level. The following subtests were given to all students: (1) Math Concepts and Estimation, (2) Math Problem-Solving and Data Interpretation, and (3) Math Computation.

The *GMADE* is a norm-referenced, standards-based assessment of mathematical skill published by Pearson Assessments. According to the publisher, the GMADE is based on highly reliable scientific research, uses the standards set forth by the NCTM, and is correlated to the new NCTM Curriculum Focal Points. The Concepts and Communication subtest for Middle Grades was selected for administration. This subtest uniquely addresses the language, vocabulary, and representations of mathematics.

The *BAM* is an open-ended, performance-based component that enables students to communicate what they know and allows for the assessment of those students who are better at communicating knowledge. The *BAM* is published by CTB and is designed to measure student performance against national and international standards. According to the publisher, the broader range and greater depth of the tasks enables this assessment to recognize, and thus encourage, students' achievements in meeting these higher standards for mathematical performance.

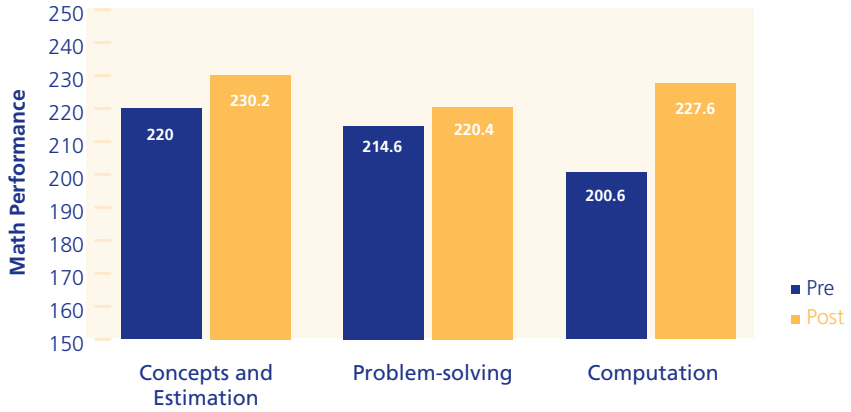
Student Performance Results

Results for *Prentice Hall Middle Grades Math* Students

Students using *Prentice Hall Middle Grades Math* statistically significantly improved their math achievement over the course of the school year in the areas of; math concepts and estimation, problem-solving and data interpretation, math computation, math vocabulary, and communication in math. Specifically, results showed that *Prentice Hall Middle Grades Math* students demonstrated significant gains of:

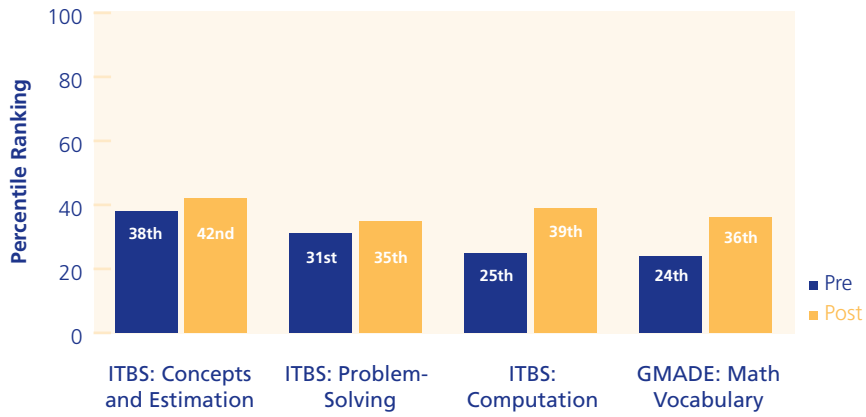
- 14 percentiles on concepts and estimation
- 7 percentiles on problem-solving and data interpretation
- 27 percentiles on computation
- 18 percentiles on math vocabulary
- 22 percentiles on math communication

Figure 1 – *Prentice Hall Middle Grades Math* Students' Math Performance at Pre- and Post-testing: ITBS



Another way to look at norm-referenced assessment results is to look at the percentile rankings of students relative to a national sample. Typically, students who experience one year's growth over one year's time maintain their percentile ranking. *Prentice hall Middle Grades Math* students had higher percentile rankings at post-testing than pre-testing on all norm-based assessments administered. This means that *Prenctice Hall Middle Grades Math* students grew more than would be expected over the course of a typical academic year as seen below in Table 2.

Figure 2 – *Prentice Hall Middle Grades Math* Students' Percentile Rankings at Pre- and Post-testing



Subgroup Results: *Prentice Hall Middle Grades Math* Students

Results also showed that *Prentice Hall Middle Grades Math* students in all subgroups significantly improved from pre- to post-testing on the vast majority of math outcomes, as evidenced by figures 3–7. Specifically, *Prentice Hall Middles Grades Math* worked equally well for:

- Females and males
- Caucasian, Hispanic, and African-American students
- Special education and non-special education students
- Students receiving free/reduced lunch and those not
- Students of low, medium, and high math ability levels

Figure 3 – *Prentice Hall Middle Grades Math* Students' Assessment Performance Gains by Gender

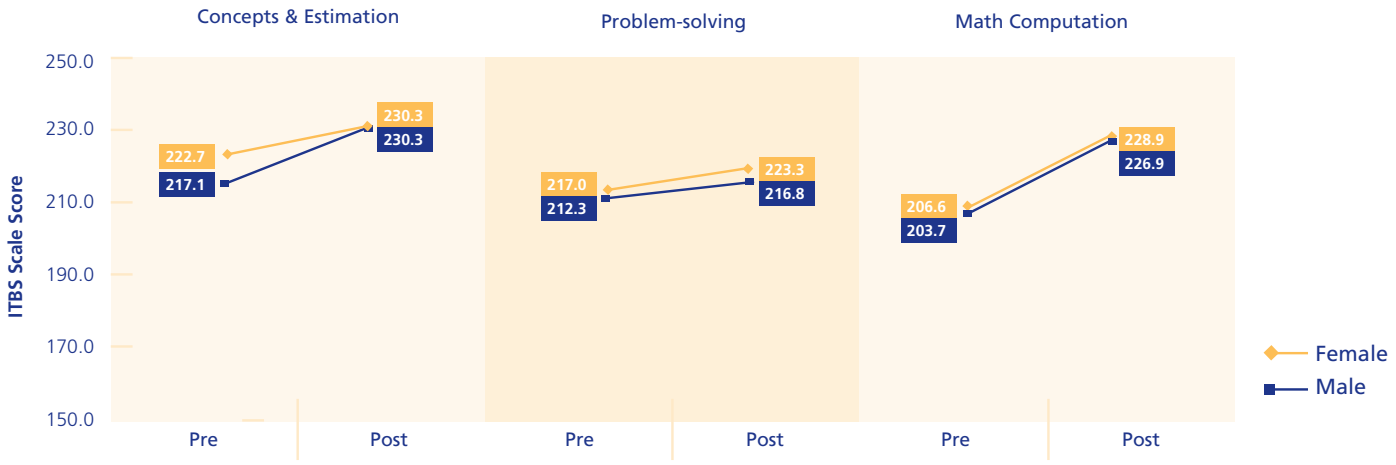


Figure 4 – *Prentice Hall Middle Grades Math* Students' Assessments Performance Gains by Ethnicity

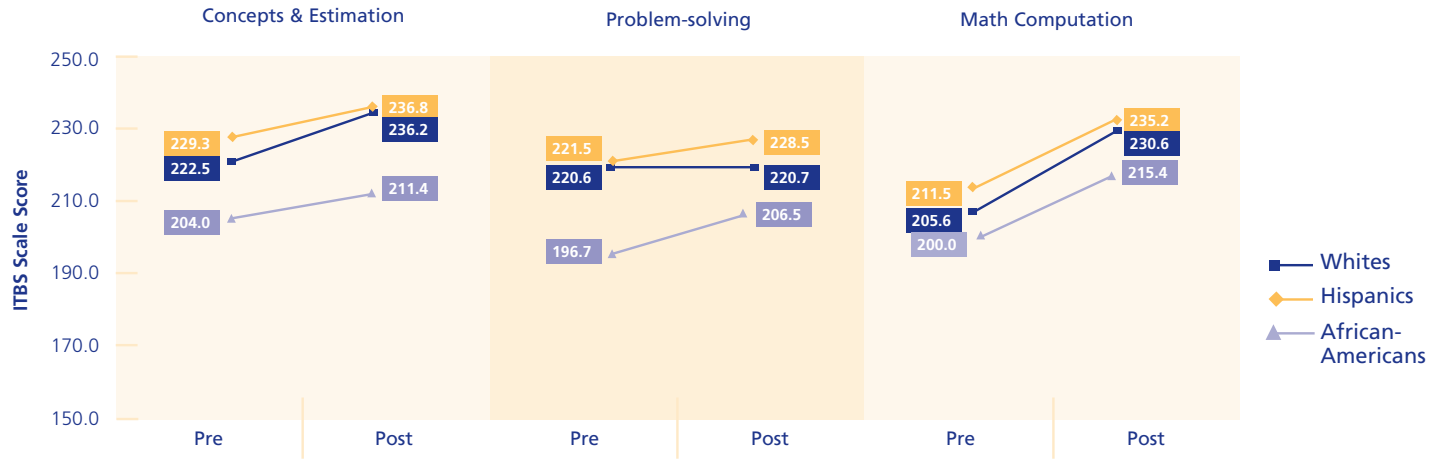


Figure 5 – *Prentice Hall Middle Grades Math* Students' Assessments Performance Gains by Special Education Status

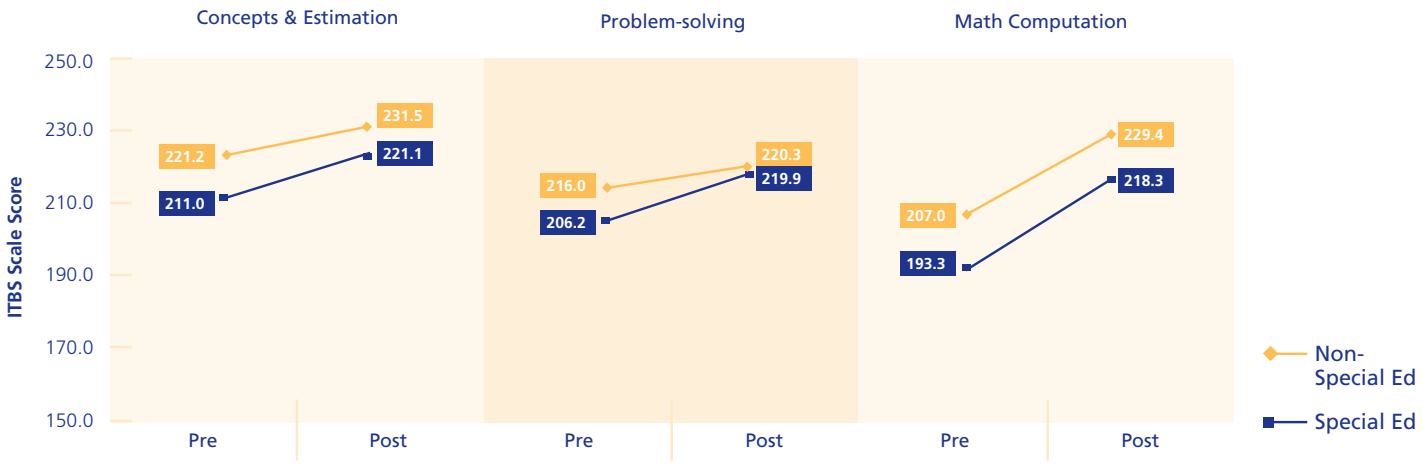


Figure 6 – *Prentice Hall Middle Grades Math* Students' Assessment Performance by Free and Reduced Lunch Status

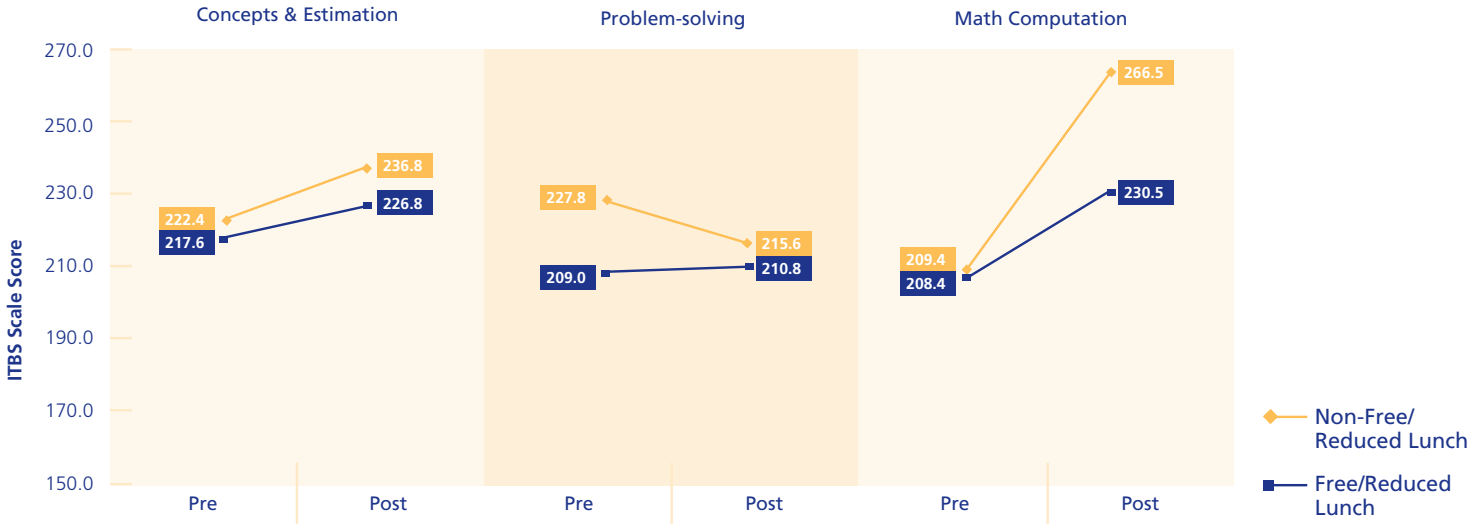
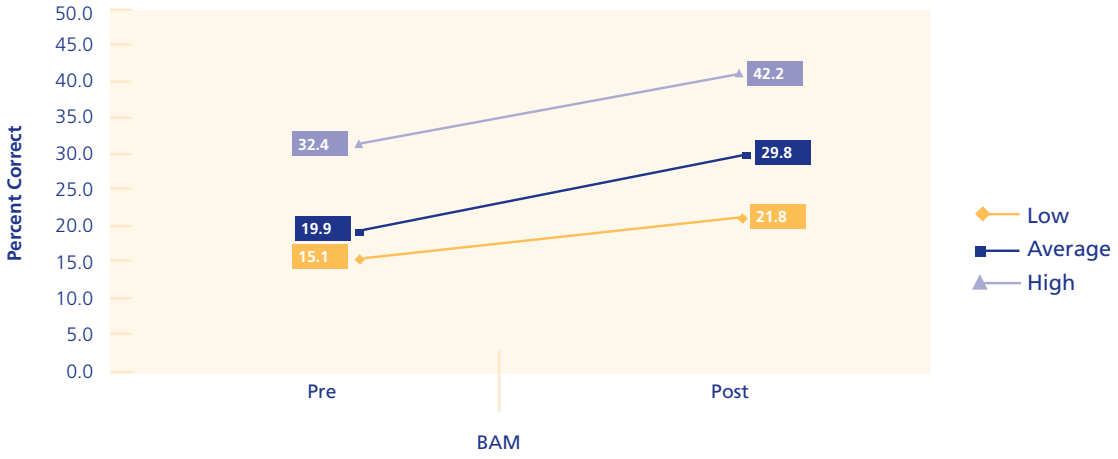


Figure 7 – *Prentice Hall Middle Grades Math* Students' Assessment Performance Gains by Math Levels



Prentice Hall Middle Grades Math students vs. students using other math programs

Evaluators conducted analyses comparing how *Prentice Hall Middle Grades Math* students performed in comparison to students using other math programs. Middle school students who used *Prentice Hall Middle Grades Math* showed greater gains in math computation and problem-solving skills as compared to students who used other math programs, as evidenced in Figure 7 and 8.

Figure 8 – Pre- and Post-test ITBS Math Performance of *Prentice Hall Middle Grades Math* and Students Using Other Math Programs: ITBS Math Computation

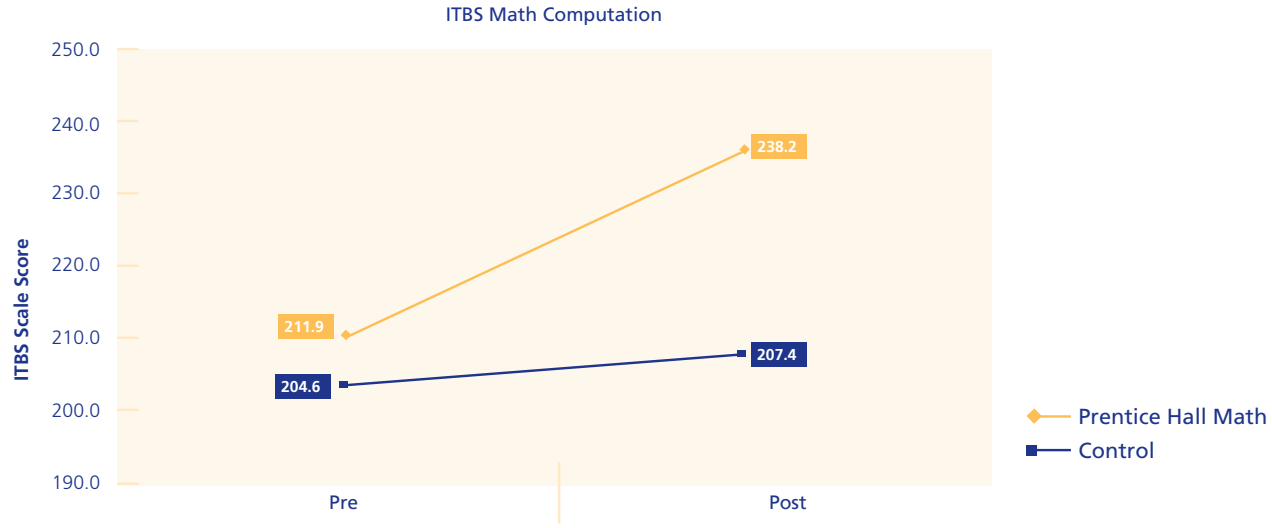
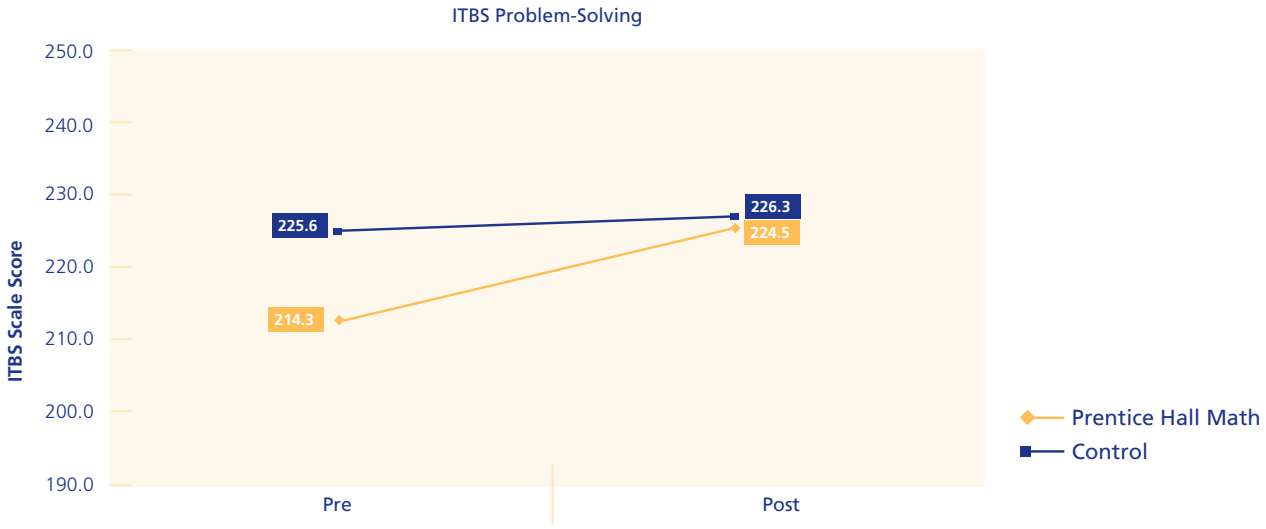


Figure 9 – Pre- and Post-test ITBS Math Performance of *Prentice Hall Middle Grades Math* and Students Using Other Math Programs: ITBS Math Computation



Prentice Hall Middle Grades Math Implementation

Data gathered from teacher observations, monthly implementation logs, and surveys were triangulated to examine the implementation of the *Prentice Hall Middle Grades Math* program. Three levels of implementation (low, moderate, and high) were assigned for treatment teachers' implementation of key program components and the percent of chapters covered. This information was then averaged to determine an overall implementation level. Moderate to high fidelity of implementation was evident among the majority of treatment teachers. Teachers tended to use the program as described in the implementation guidelines and also covered a number of chapters. The variation that did occur was in the areas of vocabulary, guided problem-solving activities, and math lab activities. In addition there was no evidence of contamination between the treatment and control groups, meaning the *Prentice Hall Middle Grades Math* program was delivered to treatment students only.

Perceptions of *Prentice Hall Middle Grades Math*

Prentice Hall Middle Grades Math was associated with positive outcomes such as greater perceptions of teacher support by *Prentice Hall Middle Grades Math* students as compared to students using other math programs. In addition, *Prentice Hall Middle Grades Math* teachers felt more prepared over the course of the school year to make connections between math and other disciplines, to engage students in the applications of math in a variety of contexts, and to teach various methods to solve math problems.

> *"I really enjoyed working with Prentice Hall Course 2. In fact, I liked it so much that if I were to teach another grade level I would definitely ask to have a set of books for that grade level or refuse to teach…"*
>
> *Prentice Hall Middle Grades Math* Teacher

Teachers who used the *Prentice Hall Middle Grades Math* program tended to be more satisfied with their math program than teachers who used other math programs. Specifically, 66% of *Prentice Hall Middle Grades Math* teachers agreed that their math program was an effective tool in math instruction compared to 53% of teachers using other math programs. Furthermore, 75% of *Prentice Hall Middle Grades Math* teachers agreed they would definitely recommend the program to other teachers as compared to only 50% of teachers using other math programs.

> *"The whole program is probably the best I've seen on the market. I've been on many math text book committees and taught for over 10 years and I've used several other programs… and comparing this* [Prentice Hall Middle Grades Mathematics] *to [those], I do prefer this."*
>
> *Prentice Hall Middle Grades Math* Teacher

In addition, *Prentice Hall Middle Grades Math* teachers reported high levels of engagement in activities such as individualizing instruction to the needs of students, providing intervention when students were in need, and taking students' prior understanding into account when planning instruction. For the most part, *Prentice Hall Middle Grades Math* teachers felt that the program was easy to use and well-organized. Approximately 75% of teachers who used the program indicated the program was easy to use and well-organized compared to 60% of teachers using other math programs.

> *"I have seen positive changes (in my students). Even on the NWEA test math scores, most of my kids from the beginning of the year until now have jumped up. Most of them have jumped 7 points, but several have jumped 15–16 points."*
>
> *Prentice Hall Middle Grades Math* Teacher

Students in *Prentice Hall Middle Grades Math* enjoyed using the program. Analysis of survey data showed that students using the program had more positive perceptions about the workbooks and computer programs they used in class compared to students from other math programs. In addition, *Prentice Hall Middle Grades Math* students were more satisfied with the types of practice problems in their math text compared to students using other math programs.

Discussion

The breadth and depth of research that supports this program proves that *Prentice Hall Middle Grades Math* is truly a scientific, evidence-based program with empirical data to prove its effectiveness in increasing student math achievement. Seventh grade students using the program showed significant growth in math skills and knowledge from pre- to post-testing. In particular, students showed learning gains in the areas of math concepts and estimation, problem-solving, math computation, math vocabulary, and communication in math— more than would be expected over the course of a typical school year. *Prentice Hall Middle Grades Math* students demonstrated growth among subgroups regardless of ethnicity, gender, special education status, free/reduced lunch status, and across a range of math abilities.

PRES Associates also found that *Prentice Hall Middle Grades Math* students demonstrated greater gains in computation and problem-solving as compared to students using other math programs. *Prentice Hall Middle Grades Math* students reported greater perceptions of teacher support, that they related what they learn in math to their daily lives, and engaged in more math vocabulary activities than students using other math programs. In addition, *Prentice Hall Middle Grades Math* teachers indicated that they felt more prepared over the course of the school year to make connections between math and other disciplines, engage students in the applications of math in a variety of contexts, and teach various methods to solve math problems. In sum, scientific research indicates that the *Prentice Hall Middle Grades Math* program is an effective and useful program for both teachers and students.

This study also investigated other outcomes associated with the use of the *Pearson Middle Grades Math* program. Further results of the final report for A Study of the Effects of the 2008 *Pearson Prentice Hall Middle Grades Math* Program prepared by PRES Associates can be found on the Pearson Web site.

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Notes

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