What Works Clearinghouse

ies INSTITUTE OF EDUCATION SCIENCES

Saxon Elementary School Math

Program Description[2]

Saxon Elementary School Math, published by Houghton Mifflin Harcourt, is a core curriculum for students in kindergarten through grade 5. A distinguishing feature of *Saxon Elementary School Math* is its use of a distributed approach, as opposed to a chapter-based approach, for instruction and assessment. The program is built on the premise that students learn best when instruction is incremental and explicit, previously learned concepts are continually reviewed, and assessment is frequent and cumulative. At each grade level, math concepts are introduced, reviewed, and practiced over time in order to move students from understanding to mastery to fluency. For grades K–3, the *Saxon Elementary School Math* curriculum emphasizes hands-on activities and teacher-directed math conversations that engage students in learning. The curriculum for grades 4–5 also uses math conversations to introduce new concepts, and shifts the focus to student-directed learning.

Research[3]

One study of *Saxon Elementary School Math* that falls within the scope of the Elementary School Math review protocol meets What Works Clearinghouse (WWC) evidence standards, and two studies meet WWC evidence standards with reservations. The three studies included students in grades K–5 from 325 schools in 19 states.[4]

Based on these three studies, the WWC considers the extent of evidence for *Saxon Elementary School Math* on elementary school students to be medium to large for mathematics achievement.

1. This report has been updated to include reviews of 13 studies that have been released since 2005. Of the additional studies, 6 were not within the scope of the protocol and 5 were within the scope of the protocol but did not meet evidence standards. A complete list and disposition of all studies reviewed are provided in the references.
2. The descriptive information for this program was obtained from a publicly available source: the program's website (http://saxonpublishers.hmhco.com/en/saxonpublishers.htm, downloaded June 2010). The WWC requests developers to review the program description sections for accuracy from their perspective. Further verification of the accuracy of the descriptive information for this program is beyond the scope of this review.
3. The studies in this report were reviewed using WWC Evidence Standards, Version 1.0 (see the WWC Standards), as described in protocol Version 1.0.
4. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.

Effectiveness

Saxon Elementary School Math was found to have mixed effects on mathematics achievement.

	Mathematics achievement
Rating of effectiveness	Mixed effects
Improvement index[5]	Average: +5 percentile points
	Range: –1 to +12 percentile points

Absence of conflict of interest

The *Math Curricula* study summarized in this intervention report was prepared by staff of Mathematica Policy Research. Because the principal investigator for the WWC review of elementary school math interventions is also a Mathematica staff member, the study was rated by staff members from the University of Wisconsin and the Optimal Solutions Group. The intervention report was reviewed by the principal investigator, a WWC Quality Assurance reviewer, and an external peer reviewer.

Additional program information

Developer and contact

Saxon Elementary School Math was developed and is distributed by Saxon Publishers, an imprint of Houghton Mifflin Harcourt Supplemental Publishers. Address: 181 Ballardvale Street, Wilmington, MA 01887. Email: greatservice@hmhpub.com. Web: http://saxonpublishers.hmhco.com/. Telephone: (800) 289-3994.

Scope of use

The first Saxon textbook, *Saxon Algebra,* was published in 1979 by John Saxon for junior college students. In 1980, a high school version, *Algebra 1,* was published. In 1981, the program was tested by 20 teachers with approximately 1,400 students. By 1993, the company had become Saxon Publishers and had developed programs for kindergarten through high school. Information is not available on the numbers or demographics of students, schools, or districts using this intervention.

Teaching

Daily lessons in grades 1–3 consist of three components: (1) the meeting, (2) the math lesson, and (3) written practice, which includes guided class practice and homework. A typical lesson begins with the meeting, during which students engage in various practical activities (for example, understanding calendars) and enter into math conversations and dialogue with their classmates and teacher to communicate their understanding of math concepts. Following the meeting, the teacher introduces new concepts during the math lesson. Hands-on activities are incorporated into the math lesson to encourage student involvement and further the learning of new concepts. The math lesson is followed by written practice, which includes teacher-facilitated guided class practice of new and previously learned concepts. Students complete the day's homework independently. Cumulative and written assessments occur every five lessons.

In kindergarten, the same three components are used but may be separated into different sessions, and assessments are conducted as individual interviews between the teacher and individual students. For grades 4 and 5, a daily lesson consists of four components: (1) the warm-up; (2) the math lesson, which introduces a new math concept; (3) practice on the new concept; and (4) mixed practice, including new and previously learned concepts. Students are introduced to concepts incrementally, given opportunities for continual review and practice, and assessed cumulatively and frequently. An assessment score of 80% or lower indicates a need for remediation, and provision for remediation is part of the program.

5. These numbers show the average and range of student-level improvement indices for findings across two of the three studies. It was not possible to calculate improvement indices for Resendez and Manley (2005) due to the lack of student-level data.

Additional program information *(continued)*

Cost

Saxon Elementary School Math for grades K–3 can be ordered as a 24-student or 32-student kit that includes all the teacher, lesson, classroom, and student materials. The student kits range from more than $600 to more than $800, depending on the size of the kit. Individual kit components, such as manipulatives, workbooks, student texts, teacher manuals, and materials in Spanish, can be purchased separately. Grades 4 and 5 have a separate student edition ($50–$55) and a teacher manual set ($185). Other ancillary materials, such as blackline master books, practice workbooks, and a test-practice generator, can be purchased separately.

Research

Twenty studies reviewed by the WWC investigated the effects of *Saxon Elementary School Math.* One study (Agodini et al., 2009) is a randomized controlled trial that meets WWC evidence standards. Two studies (Good, Bickel, & Howley, 2006; Resendez & Manley, 2005) are randomized controlled trials or quasi-experimental designs that meet WWC evidence standards with reservations. The remaining 17 studies do not meet either WWC evidence standards or eligibility screens.

Meets evidence standards

Agodini et al. (2009) examined the effects of *Saxon Elementary School Math* compared to three other curricula using a randomized controlled design involving 39 schools and 1,309 first-grade students from four school districts in Connecticut, Minnesota, New York, and Nevada. Schools were randomly assigned to use one of four curricula—*Saxon Elementary School Math; Investigations in Number, Data, and Space; Math Expressions;* or *Scott Foresman–Addison Wesley Mathematics*—for the entire school year. Each district contained at least one treatment school (using *Saxon Elementary School Math*) and at least one school using each of the three respective comparison curricula.

Meets evidence standards with reservations

Good, Bickel, and Howley (2006) used a quasi-experimental design to investigate the impacts of *Saxon Elementary School Math* with a sample of 1,476 kindergarten through third-grade students in 57 schools from across the United States. The authors matched a randomly selected sample of elementary schools currently using *Saxon Elementary School Math* to a group of comparison schools based on school size, type, grade-level configuration, and student demographics. Teachers in the comparison schools used a range of other curricula.

Resendez and Manley (2005) conducted a retrospective study that included 170 intervention schools in Georgia and 172 comparison schools that were matched to the intervention schools based on student demographics, geographical location, and baseline math performance on Georgia's Criterion-Referenced Competency Test (CRCT). The intervention schools used the *Saxon Elementary School Math* program recommended for each grade level in grades 1–8 between 2000 and 2005. The comparison schools used a variety of other curricula. The majority of comparison schools used traditional basal math curricula. One third of the schools used a mix of basal, investigative, and other approaches, and a small percentage used an investigative approach to teaching math. This intervention report presents the study's findings for grades 1–5.

Extent of evidence

The WWC categorizes the extent of evidence in each domain as small or medium to large (see the WWC Procedures and Standards Handbook, Appendix G). The extent of evidence takes into account the number of studies and the total sample size across the studies that meet WWC evidence standards with or without reservations.[6]

The WWC considers the extent of evidence for *Saxon Elementary School Math* to be medium to large for mathematics achievement for elementary school students.

6. The extent of evidence categorization was developed to tell readers how much evidence was used to determine the intervention rating, focusing on the number and size of studies. Additional factors associated with a related concept (external validity, such as the students' demographics and the types of settings in which studies took place) are not taken into account for the categorization. Information about how the extent of evidence rating was determined for *Saxon Elementary School Math* is in Appendix A6.

Effectiveness

Findings

The WWC review of interventions for Elementary School Math addresses student outcomes in mathematics achievement. The findings below present the authors' estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *Saxon Elementary School Math* on students.[7] Of the three studies reviewed, one reported statistically significant positive effects. The remaining two studies showed indeterminate effects.

Agodini et al. (2009) reported statistically significant greater achievement on the Early Childhood Longitudinal Study–Kindergarten (ECLS-K) mathematics assessment for schools using the *Saxon Elementary School Math* program compared to schools using two of the other three comparison curricula. The WWC confirmed those results and also found that impacts for *Saxon Elementary School Math* were significantly greater than the three comparison curricula considered jointly.

Good, Bickel, and Howley (2006) did not report statistical significance findings for intent-to-treat impacts. Using supplemental results supplied by the authors, the WWC calculations found no statistically significant effect of *Saxon Elementary School Math* on the performance of kindergarten through third-grade students on the mathematics subtest of the Stanford Achievement Test, Ninth Edition (SAT 9). The effect size of 0.07 on the SAT 9 does not meet the WWC criteria for substantively important effects (an effect size of 0.25 or greater).

Resendez and Manley (2005) reported no significant effects of the *Saxon Elementary School Math* program on overall math achievement in grades 1–5, as measured by Georgia's CRCT. Using school-level data provided by the authors, the WWC confirmed that *Saxon Elementary School Math* did not have a statistically significant effect on math achievement at each grade level from first to fifth grade. Due to the lack of student-level data, the effect size and improvement index could not be calculated.

Rating of effectiveness

The WWC rates the effects of an intervention in a given outcome domain as positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. The rating of effectiveness takes into account four factors: the quality of the research design, the statistical significance of the findings, the size of the difference between participants in the intervention and the comparison conditions, and the consistency in findings across studies (see the WWC Procedures and Standards Handbook, Appendix E).

The WWC found *Saxon Elementary School Math* to have mixed effects for mathematics achievement for elementary school students

Improvement index

The WWC computes an improvement index for each individual finding. In addition, within each outcome domain, the WWC computes an average improvement index for each study and an average improvement index across studies (see the WWC Procedures and Standards Handbook, Appendix F). The improvement index represents the difference between the percentile rank of the average student in the intervention condition and the percentile rank of the average student in the comparison condition. Unlike the rating of effectiveness, the improvement index is entirely based on the size of the effect, regardless of the statistical significance of the effect, the study design, or the analysis. The improvement index can take on values between –50 and +50, with positive numbers denoting favorable results for the intervention group.

The student-level improvement index could not be computed for one of the three studies because student-level standard deviations were not available. Across the remaining two studies,

7. The level of statistical significance was reported by the study authors or, when necessary, calculated by the WWC to correct for clustering within classrooms or schools and for multiple comparisons. For an explanation, see the WWC Tutorial on Mismatch. For the formulas the WWC used to calculate the statistical significance, see the WWC Procedures and Standards Handbook, Appendix C for clustering and the WWC Procedures and Standards Handbook, Appendix D for multiple comparisons. In the cases of Agodini et al. (2009) and Resendez and Manley (2005), no corrections for clustering or multiple comparisons were needed. In the case of Good, Bickel, and Howley (2006), a correction for clustering was needed, so the significance levels may differ from those reported in the original study.

The WWC found *Saxon Elementary School Math* to have mixed effects for mathematics achievement for elementary school students *(continued)*

the average improvement index for mathematics achievement is +5 percentile points, with a range of –1 to +12 percentile points across findings.

Summary

The WWC reviewed 20 studies on *Saxon Elementary School Math* for elementary school students. One of these studies meets WWC evidence standards; two studies meet WWC evidence standards with reservations; the remaining 17 studies do not meet either WWC evidence standards or eligibility screens. Based on the three studies, the WWC found mixed effects on mathematics achievement for elementary school students. The conclusions presented in this report may change as new research emerges.

References

Meets WWC evidence standards

Agodini, R., Harris, B., Atkins-Burnett, S., Heaviside, S., Novak, T., & Murphy, R. (2009). *Achievement effects of four early elementary school math curricula: Findings from first graders in 39 schools* (NCEE 2009-4052). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Meets WWC evidence standards with reservations

Good, K., Bickel, R., & Howley, C. (2006). Saxon Elementary Math *program effectiveness study.* Charlestown, WV: Edvantia.

Resendez, M., & Manley, M. A. (2005). *The relationship between using* Saxon Elementary and Middle School Math *and student performance on Georgia statewide assessments.* Orlando, FL: Harcourt Achieve.

Studies that fall outside the Elementary School Math review protocol or do not meet WWC evidence standards

Calvery, R., Bell, D., & Wheeler, G. (1993, November). *A comparison of selected second and third graders' math achievement: Saxon vs. Holt.* Paper presented at the meeting of the Mid-South Educational Research Association, New Orleans, LA. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Christofori, P. (2005). *The effect of direct instruction math curriculum on higher-order problem solving.* Unpublished doctoral dissertation, University of South Florida, Sarasota, FL. The study is ineligible for review because it does not use a comparison group.

Cummins-Colburn, B. J. L. (2007). Differences between state-adopted textbooks and student outcomes on the Texas Assessment of Knowledge and Skills examination. (Doctoral dissertation, Touro University International). *Dissertation Abstracts International, 68*(06A), 168–2299. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Doe, C. (2006). Marvelous math products. *MultiMedia & Internet@Schools, 13*(3), 30–33. The study is ineligible for review because it does not examine the effectiveness of an intervention.

Fahsl, A. J. (2001). An investigation of the effects of exposure to Saxon math textbooks, socioeconomic status and gender on math achievement scores. *Dissertation Abstracts International, 62*(08), 2681A. The study is ineligible for review because it does not use a comparison group.

Hansen, E., & Greene, K. (2000). *A recipe for math. What's cooking in the classroom: Saxon or Traditional?* Retrieved May 4, 2006, from http://www.secondaryenglish.com/recipeformath.html. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Harcourt Achieve, Inc. (2005). *Case study research summaries of* Saxon Math. Retrieved December 15, 2009, from http://saxonpublishers.hmhco.com/en/resources/result_c.htm?ca=Research%3a+Efficacy&SRC1=4. The study is ineligible for review because it does not use a comparison group.

References *(continued)*

Hook, W., Bishop, W., & Hook, J. (2007). A quality math curriculum in support of effective teaching for elementary schools. *Educational Studies in Mathematics, 65*(2), 125–148. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Klein, D. (2000). *High achievement in mathematics: Lessons from three Los Angeles elementary schools.* Washington, DC: Brookings Institution Press. The study is ineligible for review because it does not use a comparison group.

Nguyen, K., Elam, P., & Weeter, R. (1993). *The 1992–93* Saxon *mathematics program evaluation report.* Oklahoma City: Oklahoma City Public Schools. The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—since the intervention was not implemented as designed.

Plato, J. (1998). *An evaluation of* Saxon Math *at Blessed Sacrament School.* Retrieved May 4, 2006, from http://lrs.ed.uiuc.edu/students/plato1/Final.html. The study is ineligible for review because it does not use a comparison group.

Resendez, M., & Azin, M. (2007). *The relationship between using* Saxon Elementary and Middle School Math *and student performance on California statewide assessments.* Jackson, WY: PRES Associates. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Additional source:

Resendez, M., & Azin, M. (2007). Saxon Math *and California English Learners' math performance: Research brief.* Jackson, WY: PRES Associates.

Resendez, M., & Azin, M. (2008). *The relationship between using* Saxon Math *at the elementary and middle school levels and student performance on the North Carolina statewide assessment: Final report.* Jackson, WY: PRES Associates. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Resendez, M., Sridharan, S., & Azin, M. (2006). *The relationship between using* Saxon Elementary School Math *and student performance on Texas statewide assessments.* Jackson, WY: PRES Associates. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Slavin, R. E., Cheung, A., Groff, C., & Lake, C. (2008). Effective reading programs for middle and high schools: A best-evidence synthesis. *Reading Research Quarterly, 43*(3), 290–322. The study is ineligible for review because it is not a primary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Viadero, D. (2009). Study gives edge to 2 math programs. *Education Week, 28*(23), 1–13. The study is ineligible for review because it does not examine the effectiveness of an intervention.

Vinogradova, E., King, C., & Rhoades, T. (2008, April). *Success for all students: What works? Best practices in Maryland public schools.* Paper presented at the annual meeting of the American Sociological Association, Boston, MA. The study is ineligible for review because it does not examine the effectiveness of an intervention.