

What Works Clearinghouse



Saxon Math

Program Description² *Saxon Math* is a textbook series covering grades K–12 based on incremental development and continual review of mathematical concepts to give students time to learn and practice concepts throughout the year. The series is aligned with standards of the National Council of Teachers of Mathematics (NCTM) and various states, and can be adapted for special education students in inclusion classrooms, pullout programs, or self-contained resource classrooms. Although content differs by course, the incremental, distributed approach of *Saxon Math* is the same, with mathematical

concepts presented in a series of short “lessons” intended to gradually build understanding and previously-taught concepts practiced and assessed throughout the course. Developed in the early 1980s, *Saxon Math* included four middle school math textbooks used in the studies included in this intervention report. The series has been redesigned and now offers three textbooks for middle school grades. This report includes studies that investigate the potential impact of *Saxon Math* texts on math achievement of middle school students but does not include these revised texts.

Research³ One study of *Saxon Math* meets What Works Clearinghouse (WWC) evidence standards, and four studies meet WWC evidence standards with reservations. The five studies included over 6,500 students from grades 6 to 8 in 52 schools in four states.⁴

Based on these five studies, the WWC considers the extent of evidence for *Saxon Math* to be medium to large for math achievement.

1. This report has been updated from the previous version (posted April 9, 2007) to include reviews of five studies that have been released since 2005. A complete list and disposition of all studies reviewed is provided in the references. One study that met evidence standards (Williams, 1986), which was included in the previous version of this report, is now eligible for review as part of the WWC high school math area. (The protocol for the middle school math topic area was revised to narrow the scope from examining all students in grades 6 to 9 to examining only those students who are attending middle schools or junior high schools. Studies examining students in grade 9 who are attending high school are included in the high school math topic area.) Additionally, two studies included in the previous version do not meet evidence standards: Resendez and Manley (2005) does not meet evidence standards because the groups were not shown to be equivalent at baseline; Roberts (1994) does not meet evidence standards because the WWC views the district as the unit of assignment in the study, thus, there was only one unit of assignment in each condition.
2. The descriptive information for this program was obtained from publicly available sources: the program’s website (<http://saxonpublishers.hmhco.com>, downloaded December 2008), and directly from the authors in the case of Resendez and Azin (2006). 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. The literature search reflects documents publicly available by August 2008.
3. The studies in this report were reviewed using WWC Evidence Standards, Version 1.0 (see the WWC Standards).
4. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.

Effectiveness *Saxon Math* was found to have mixed effects on math achievement.

	Math achievement
Rating of effectiveness	Mixed effects
Improvement index⁵	Average: +9 percentile points Range: +6 to +16 percentile points

Additional program information

Developer and contact

Originally developed by John Saxon, *Saxon Math* is distributed by Houghton Mifflin Harcourt Supplemental Publishers. Address: Harcourt Achieve, Attn: Customer Service, 5th Floor, 6277 Sea Harbor Drive, Orlando, FL 32887. Email: info@SaxonPublishers.com. Web: <http://saxonpublishers.hmhco.com>. Telephone: (800) 531-5015.

Scope of use

Saxon Math's first textbook (*Algebra I* for ninth grade) was published in 1980. By 1986, four books were available: *Algebra 1*, *Algebra 2*, *Algebra ½*, and *Advanced Mathematics*. By 1993, the company had published 13 books and programs for students in kindergarten through high school.

Currently, there are three textbooks used to teach middle school math: *Saxon Math Course 1* for grade 6, *Saxon Math Course 2* for grade 7, and *Saxon Math Course 3* for grade 8. Information regarding the number and demographics of students, schools, or districts currently using *Saxon Math* is not available.

Teaching

The *Saxon Math* curriculum for each grade level consists of at least 120 daily lessons and 12 activity-based investigations. A daily lesson consists of warm-up activities (10–15 minutes) for building automatic recall of math foundations, computational skills and facts, number sense, and problem solving; introduction to the new concept (5–10 minutes); and distributed practice to strengthen understanding of previously learned concepts (20–30 minutes). Cumulative assessments are given after every five lessons. *Saxon Math* can be adapted for special education or home schooled students.

Cost

Each two-volume Teacher's Manual costs \$96.15, and each student edition textbook costs between \$56 and \$59. Other available materials include posters, manipulatives, and guides for adapting the *Saxon Math* curriculum for special education students.

Research

Nineteen studies reviewed by the WWC investigated the effects of *Saxon Math*. One study (Resendez & Azin, 2006) is a randomized controlled trial that meets WWC evidence standards. Four studies (Peters, 1992; Crawford & Raia, 1986;

Resendez, Fahmy, & Manley, 2005, Cohort A; and Resendez, Fahmy, & Manley, 2005, Cohort F) are randomized controlled trials or quasi-experimental designs that meet WWC evidence standards with reservations. Two of these studies (Resendez,

5. These numbers show the average and range of student-level improvement indices for all findings across the studies.

Research (continued)

Fahmy, & Manley, 2005, Cohort A and Resendez, Fahmy, & Manley, 2005, Cohort F) were included within one research report.⁶ The remaining 14 studies do not meet either WWC evidence standards or eligibility screens.

Meets evidence standards

Resendez and Azin (2006) conducted a randomized controlled trial to investigate the effect of *Saxon Math* on math achievement in one northeastern Ohio middle school and one southwestern Ohio junior high school.⁷ The schools served sixth-, seventh-, and eighth-grade students living in urban and suburban locations; classes were randomly assigned to use *Saxon Math* or control curricula during the 2005–06 school year. The analysis sample included 14 *Saxon Math* classrooms (approximately 260 students) and 11 control classrooms (more than 200 students). Classes in the intervention group used one of four *Saxon Math* curricula (*Saxon 7/6*, 2004-4th Ed.; *Saxon 8/7*, 2004-4th Ed.; *Saxon Algebra ½*, 2004-3rd Ed.; or *Saxon Algebra 1*, 2003-3rd Ed.); classes in the control group used either a traditional basal program or a mixed curriculum consisting primarily of teacher-created materials.

Meets evidence standards with reservations

Peters (1992) conducted a randomized controlled trial that had non-random allocations after random assignment to investigate

the effect of *Saxon Math* on math achievement of 36 “math-talented” eighth-grade students from one junior high school in Nebraska during the 1991–92 school year.^{8,9} The district borders two large cities (Lincoln and Omaha) and its students lived in rural and suburban areas. Students in the intervention group used the *Saxon Algebra 1* textbook (1981), while students in the comparison group used the *University of Chicago School Mathematics Project (UCSMP) Algebra* first-edition textbook.

Crawford and Raia (1986) conducted a within-teacher, matched-comparison quasi-experiment to investigate the effect of *Saxon Math* on math achievement of eighth-grade students in Oklahoma City Public Schools during the 1984–85 school year. The analysis sample included 78 eighth-grade students (39 *Saxon* and 39 comparison) taught by four teachers from four middle schools. Students in the intervention group used the *Saxon Algebra ½* (1983) textbook, and students in the comparison group used the Scott-Foresman *Mathematics* (1980) textbook.

Resendez, Fahmy, and Manley (2005, Cohort A) conducted a quasi-experiment to investigate the effect of *Saxon Math* on math achievement in 25 middle schools serving sixth-, seventh-, and eighth-grade students in rural, suburban, and urban districts in Texas. The analysis sample for Cohort A (grade 8 of Sample 1) included 1,472 students from 12 intervention schools who received three years of *Saxon Math* exposure in grades 6, 7,

6. The study authors reported on three independent samples containing multiple cohorts of students. Sample 2 was excluded from WWC review because this sample was used for a pre-post analysis of the students in *Saxon Math* schools and did not include a comparison group. Cohorts B and C of Sample 1 were included only in an analysis of tenth-grade math performance. Because it is unknown whether the intervention and comparison groups for these cohorts attended similar schools in grades 9 and 10, it is impossible to determine whether the effects can be attributed solely to *Saxon Math*; therefore, the WWC excluded these cohorts from this review. Cohorts G and H of Sample 3 were excluded because pre-*Saxon* math achievement data were not available for these students and, consequently, baseline equivalence could not be established. Cohort A (grade 8 of Sample 1) and Cohort F (grade 6 of Sample 3) were treated as separate studies because they examined the effects of *Saxon Math* on different samples of students at two different times. Students in Cohort A were in grade 8 in 2000–01; students in Cohort F were in grade 6 in 2003–04.
7. In the case of Resendez and Azin (2006), differences between intervention and control groups on pretest, and several demographic characteristics, were statistically significant at the student level but not at the classroom level. The study authors statistically controlled for these baseline differences in their analysis. Because random assignment was well executed, the WWC categorizes the study as a randomized controlled trial.
8. Peters (1992) compared *Saxon Math* with *UCSMP Algebra*. The author indicates that a random selection of numbers was used to divide participants between the intervention and comparison groups. However, the assignment of students was altered to accommodate scheduling difficulties and student requests for other course offerings. Therefore, the study meets standards with reservations, according to WWC criteria.
9. The “math-talented” designation is based on teacher recommendations and prior academic achievement. No information is provided on the specific thresholds that were used in delineating the math-talented criteria; however, all students in the sample scored at or above the 87th percentile on the California Achievement Test total math battery.

Research *(continued)*

and 8 and 1,582 students from 13 comparison schools during the 1998–99 through 2000–01 school years. Schools in the intervention group used three *Saxon Math* curricula (*Saxon 7/6*, *Saxon 8/7*, or *Saxon Algebra ½*); the majority of schools in the comparison group used core basal math curricula, which typically consist of a chapter-based approach to math instruction.¹⁰

Resendez, Fahmy, and Manley (2005, Cohort F) conducted a quasi-experiment to investigate the effect of *Saxon Math* on math achievement in 20 middle schools serving sixth-, seventh-, and eighth-grade students in rural, suburban, and urban districts in Texas. The analysis sample for Cohort F (grade 6 of Sample 3) included 1,526 sixth-grade students from ten intervention schools who received one year of *Saxon Math* exposure and 1,407 students from ten comparison schools during the 2003–04 school year. Schools in the intervention group

used two *Saxon Math* curricula (*Saxon 7/6* or *Saxon 8/7*); the majority of schools in the comparison group used core basal math curricula, which typically consist of a chapter-based approach to math instruction.¹⁰

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.¹¹

The WWC considers the extent of evidence for *Saxon Math* to be medium to large for math achievement.

Effectiveness Findings

The WWC review of interventions for Middle School Math addresses student outcomes in the math achievement domain. The findings below present the authors' estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *Saxon Math* on students.¹²

Math Achievement

Resendez and Azin (2006) reported positive but not statistically significant effects of *Saxon Math* on math achievement based on TerraNova Math Total and TerraNova Math Computation Total test scores. The effect sizes calculated by the

WWC were not large enough to be considered substantively important according to WWC criteria (an effect size of at least 0.25).¹³

Peters (1992) reported a positive but not statistically significant effect of *Saxon Math* on math achievement based on Orleans-Hanna Prognosis Test test scores. The effect size was not large enough to be considered substantively important by WWC criteria (an effect size of at least 0.25).

Crawford and Raia (1986) reported a positive and statistically significant effect of *Saxon Math* on math achievement based on California Achievement Test (CAT) Total Math test scores. The statistical significance of this effect was not confirmed by

10. The authors did not provide information on the edition and publication year of the *Saxon Math* texts used in the study.
11. The extent of evidence categorization was developed to assess 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 Math* is in Appendix A6.
12. 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 WWC Procedures and Standards Handbook, Appendix C for clustering and WWC Procedures and Standards Handbook, Appendix D for multiple comparisons. Corrections for clustering were conducted for both analysis samples included from Resendez, Fahmy, and Manley (2005). No studies required corrections for multiple comparisons.
13. The effect size formula used by Resendez and Azin (2006) differs from the formula used by the WWC and yields a different effect size.

Effectiveness *(continued)*

WWC analysis.¹⁴ However, the effect size was large enough to be considered substantively important according to WWC criteria (an effect size of at least 0.25).

Resendez, Fahmy, and Manley (2005, Cohort A) reported a positive and statistically significant effect of *Saxon Math* for the grade 8 cohort on math achievement based on the Texas Assessment of Academic Skills (TAAS) math scores. After accounting for the use of different levels of assignment and analysis, the WWC determined this finding was not statistically significant or large enough to be considered substantively important by WWC criteria (an effect size of at least 0.25).

Resendez, Fahmy, and Manley (2005, Cohort F) reported a positive and statistically significant effect of *Saxon Math* for the grade 6 cohort on math achievement based on the Texas Assessment of Knowledge and Skills (TAKS) math test. After accounting for the use of different levels of assignment and analysis, the WWC determined that this finding was not statistically significant, but the effect size was large enough to be

considered substantively important according to WWC criteria (an effect size of at least 0.25).

In sum, in the math achievement domain, the WWC reviewed findings from five studies. Two of these studies showed substantively important positive effects, and the remaining three studies showed indeterminate effects. One study used a strong design.

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 Math* to have mixed effects for math achievement

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 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 average improvement index for math achievement is +9 percentile points across the five studies, with a range of +6 to +16 percentile points across findings.

Summary

The WWC reviewed 19 studies on *Saxon Math*. One study meets WWC evidence standards; four studies meet WWC evidence standards with reservations; the remaining 14 studies do not meet either WWC evidence standards or eligibility screens. Based on the five studies, the WWC found mixed effects on math achievement. The conclusions presented in this report may change as new research emerges.

14. Crawford and Raia (1986) reported, and the WWC confirmed, that there was not a statistically significant difference in posttest means between the *Saxon Math* and comparison groups and that the two groups had identical pretest means. In an additional analysis, the authors reported that controlling for pretest produced a statistically significant effect of *Saxon Math*; the WWC could not confirm the reported significance level for this analysis, and WWC calculations indicated the effect was not statistically significant.

References **Meets WWC evidence standards**

Resendez, M., & Azin, M. (2006). *Saxon Math randomized control trial: Final report*. Jackson, WY: PRES Associates, Inc.

Meets WWC evidence standards with reservations

Crawford, J., & Raia, F. (1986). *Analyses of eighth grade math texts and achievement*. Oklahoma City, OK: Oklahoma City Public Schools, Planning, Research, and Evaluation Department.

Peters, K. G. (1992). Skill performance comparability of two algebra programs on an eighth-grade population. *Dissertation Abstracts International*, 54(01), 77A. (UMI No. 9314428)

Resendez, M., Fahmy, A., & Manley, M. A. (2005). Cohort A. *The relationship between using Saxon Middle School Math and student performance on Texas statewide assessments*. Available online from Harcourt Achieve: http://saxonpublishers.hmhco.com/HA/correlations/pdf/s/SXMath_Middle_TX_research_web.pdf. (Cohort A).

Resendez, M., Fahmy, A., & Manley, M. A. (2005). Cohort F. *The relationship between using Saxon Middle School Math and student performance on Texas statewide assessments*. Available online from Harcourt Achieve: http://saxonpublishers.hmhco.com/HA/correlations/pdf/s/SXMath_Middle_TX_research_web.pdf. (Cohort F).

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

Andrus, H. A. (2005). *Metacognitive instruction in the realm of sixth grade Saxon Math*. Unpublished doctoral dissertation, Mount Mary College, Milwaukee, WI. The study is ineligible for review because it does not use a comparison group.

Baldree, C. L. P. (2003). *The effectiveness of two mathematical instructional programs on the mathematics growth of eighth grade students*. Unpublished doctoral dissertation, University of Georgia, Athens. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Clay, D. W. (1998). *A study to determine the effects of a non-traditional approach to Algebra instruction on student achievement*. Unpublished master's thesis, Salem-Teikyo University, Salem, WV. (ERIC Document Reproduction Service No. ED428963). The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Fitzpatrick, S. B. (2001). An exploratory study of the implementation of an educational technology in two eighth grade mathematics classes. *Dissertation Abstracts International*, 62(06), 2082A. (UMI No. 3016656) The study is ineligible for review because it does not examine the effectiveness of an intervention.

Imrisek, J. P. (1989). *Incremental development: A more effective means of mathematics instruction?* Unpublished master's thesis, Bloomsburg University, Bloomsburg, PA. The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Lafferty, J. F. (1996). The links among mathematics text, students' achievement, and students' mathematics anxiety: A comparison of the incremental development and traditional texts. *Dissertation Abstracts International*, 56(08), 3014A. (UMI No. 9537085) The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

McNeil, N., Grandau, L., Knuth, E., Alibali, M., Stephens, A., Hattikudur, S., et al. (2006). Middle-school students' understanding of the equals sign: The books they read can't help. *Cognition and Instruction*, 24(3), 367. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Rentschler, R. V. (1994). The effects of Saxon's incremental review on computational skills and problem-solving achievement of sixth-grade students. *Dissertation Abstracts*

References *(continued)*

International, 56(02), 484A. (UMI No. 9518017) The study does not meet evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Resendez, M., & Azin, M. (2007). *The relationship between using Saxon Elementary and Middle-School Math and student performance on California statewide assessments*. Jackson, WY: Saxon. 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 learner's math performance: Research brief*. Jackson, WY: Saxon.

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*. Jackson, WY: PRES Associates, Inc. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

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. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Roberts, F. H. (1994). The impact of the *Saxon Mathematics* program on group achievement test scores. *Dissertation Abstracts International*, 55(06), 1498A. (UMI No. 9430198) The study does not meet evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Saxon, J. (1982). Incremental development: A breakthrough in mathematics. *Phi Delta Kappan*, 63(4), 482–484. The study does not meet evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Williams, D. D. (1986). *The incremental method of teaching Algebra I*. Kansas City: University of Missouri. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.