What Works Clearinghouse

Detailed Study Report

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

WWC Study Reports are intended to support decision making; neither the What Works Clearinghouse (WWC) nor the U.S. Department of Education endorses any interventions. No single Study Report should be used as a basis for making policy decisions because (1) few studies are designed and implemented flawlessly and (2) all studies are tested on a limited number of participants, using a limited number of outcomes, at a limited number of times, so generalizing from one study to any context is very difficult. To highlight these issues, the WWC Study Reports describe in detail the specifics of each study, focusing primarily on studies that provide the best evidence of effects (randomized controlled trials). Systematic reviews of the evidence will be conducted to summarize the results of the individual studies.

See the WWC Brief Study Report (PDF) for a summary of this study.

Topic:	Curriculum-Based Interventions for Increasing K-12 Math Achievement—Middle School
Intervention:	Saxon Math (*Saxon Algebra 1/2*)
Research Design:	Quasi-Experimental Design with Stratified Matching
Study Rating:	
Date Released:	March 4, 2005
Summary of Results:	Crawford and Raia (1986) found that students in the intervention group scored significantly higher than students in the comparison group on math computation, but not on total math or math concepts. Since the analysis was done at the student level while the intervention assignment was at the classroom level, caution should be used in interpreting the results.

= Meets Evidence Standards = Meets Evidence Standards with Reservations = Does Not Meet Evidence Standards

Intervention: Saxon Math

Operational Features

Saxon Math is a series of mathematics curricula designed for use in kindergarten through grade 12. According to the developers, the Saxon philosophy for teaching mathematics, irrespective of grade, is that children develop and retain mathematics skills best when curricula are based on four principles: (1) instruction is incremental and distributed across each grade level; (2) students have the opportunity for continual practice across each grade level; (3) assessments of student knowledge are cumulative and occur frequently across each grade level; and (4) mathematics is taught via direct instruction. The Saxon textbooks break up all concepts into increments (i.e., small, understandable pieces) and the content covered within and across each grade builds upon previously learned concepts. Topics are never dropped, but they increase in complexity.

According to the developers, *Saxon Math* covers all five content and skill areas of the National Council of Teachers of Mathematics (NCTM) standards, and the content and skills also meet various state standards. Each grade of *Saxon Math* consists of 120 daily lessons and 12 activity-based investigations. Teachers facilitate each daily lesson, which consists of a warm-up, introduction to the new concept, practice focusing on the new concept, and practice focusing on both the new and previously learned concepts. Students are assessed cumulatively, every fifth lesson, and must master a lesson at 80% or better before moving on to the next lesson. A number of materials are available at each grade level and, according to the developers, a number of supports are available to teachers of *Saxon Math.*

In this study, students using *Saxon Algebra 1/2* were compared to students using the Scott-Foresman Mathematics curriculum.

People, Settings, and Timing

Crawford and Raia (1986) conducted three studies with different subsets of the overall sample. This study report focuses on the strongest because it used a matched sample only, which accounts for differences between schools and teachers. The target population in the third study consisted of four teachers within four pilot middle schools in the Oklahoma City Public Schools (OCPS). All four teachers taught both the intervention (Saxon) and comparison (Scott-Foresman) texts. All students were from the 8th grade. Students in both the intervention and comparison groups were assessed on the outcome measure at the end of the academic year in 1985.

Cost Information

Crawford and Raia do not provide cost information for implementing *Saxon Math* in the OCPS. However, extensive cost information for the Saxon math curricula and related materials is available on the developers' website (www.saxonpublishers.com).

Intended Duration

Saxon Math is a curriculum that consists of 120 daily lessons. However, Crawford and Raia do not indicate how many lessons students in the *Saxon Math* classrooms completed and how many lessons need to be completed for the curriculum to be implemented as intended. The curriculum was piloted in the OCPS middle schools during the 1984–1985 academic year.

Scientific Rationale

Crawford and Raia offer no scientific rationale for conducting this evaluation. However, they state that OCPS had already evaluated two previous Saxon curricula (*Saxon Algebra 1* and *Saxon Algebra 1 1/2*). The studies of *Saxon Algebra 1* concluded that students who participated in the Saxon classrooms scored significantly higher than students in the "status quo" classrooms on two algebra outcome measures, so OCPS adopted the *Saxon Algebra 1* text. The study of *Saxon Algebra 1 1/2* found no statistically significant effect of the Saxon text over the status quo, and the evaluator recommended that OCPS not adopt the *Saxon Algebra 1 1/2* text. As stated by Crawford and Raia, when Saxon introduced a third textbook (*Saxon Algebra 1/2*), OCPS wanted to conduct a pilot study to determine its effectiveness since

the previous studies of the Saxon textbooks had produced mixed results. The study was needed to address the school district's interest in determining what educational treatments enhance student achievement.

Overview of the Study

Purpose

This evaluation was designed to compare student achievement scores of students enrolled in *Saxon Algebra 1/2* classrooms (intervention group) with students enrolled in Scott-Foresman Mathematics classrooms (comparison group). A secondary purpose was to compare the textbook content of *Saxon Algebra 1/2* and Scott-Foresman Mathematics. The WWC only reviews evidence in relation to achievement; therefore, the comparison of textbook content is not reviewed further in this study report. As stated above, Crawford and Raia conducted three analyses, but this study report focuses on the strongest analysis of the three and describes how *Saxon Algebra 1/2* compared to the comparison text only for those teachers who taught both textbooks in a sample of students matched on pretest California Achievement Test (CAT) total math scores.

Intervention Fidelity

As described by the curriculum developers, *Saxon Algebra 1/2* is intended to be a full-year program of instruction, lessons are designed to be one hour daily (this includes practice and review time), and assessments are to occur every fifth lesson, usually on each Friday of the week. Crawford and Raia do not provide any information about the implementation of the curriculum or teacher training. Teachers do have access to various supports and resources through the *Saxon Math* website and telephone support.

Outcome Measures

The outcome measure was the CAT total math, math computation, and math concepts scores. The CAT is a nationally normed, valid, and reliable test designed to measure achievement in the basic skills taught in school. The outcome measure was administered at the end of the academic year in 1985 and appears to be well aligned to the curriculum.

Research Design

The research design of study three was quasi-experimental, and this study report only reviews the evidence related to the stratified matched sample within the third study. It is not clear how Crawford and Raia selected the overall sample for the study or how the sample was placed in groups except that it appears to be somewhat of a convenience sample (some of the teachers used the intervention text and some of them used the comparison text). For study three, Crawford and Raia focused only on those teachers who taught both the intervention and comparison textbooks. Because there were pretest CAT total math achievement differences between students, Crawford and Raia used stratified matching to select a sample of students who had exactly the same mean on pretest total math scores for the teachers that taught both the intervention and comparison texts.

Participant Flow

Crawford and Raia assigned participants to the intervention and comparison groups at the level of the class. At the beginning of study three, four teachers taught both the *Saxon Algebra 1/2* and the Scott-Foresman Mathematics curricula. The number of 8th-grade students in the intervention group was 72 and in the comparison group was 259. For this study report, the matched sample at the beginning of study three consisted of four teachers who taught both curricula. The number of 8th-grade students in the matched sample was 39 in the intervention group and 39 in the comparison group.

Reference Periods

Crawford and Raia piloted *Saxon Algebra 1/2* in the OCPS middle schools during the 1984-1985 academic year. The CAT was administered at the end of the 1985 academic year.

Baseline Data

Crawford and Raia did not describe baseline characteristics for the intervention and comparison groups except for the grade level of the students. Crawford and Raia also pretested the students on the CAT and used the CAT total math score as a pretest to match a subset of the third study sample. (See Table 1.)

There were significant pretest differences between groups and Crawford and Raia used matching on total math pretest scores to control for these pretest differences in the analyses of interest for this study report.

Statistical Methods

Crawford and Raia conducted the analysis of the matched sample in study three at the student level, representing a mismatch between unit of assignment and unit of analysis. In study three, Crawford and Raia performed a number of analyses. Crawford and Raia utilized analyses of variance (ANOVAs) to compare total math, math computation, and math concepts scores between the matched intervention and comparison groups. Crawford and Raia present pretest, posttest, and gain score means, standard deviations, and *F* statistics for each of the analyses, but only the posttest scores are presented in Table 2 and analyses of posttest outcomes scores are reported in the next section.

Outcomes and Estimation

Table 2 and Figures 1a-c present the effects of the *Saxon Algebra 1/2* curriculum on CAT total math, math computation, and math concepts scores, as reported by Crawford and Raia. The ANOVA analyses indicate that students in the intervention group scored significantly higher on one of three measures, math computation, than students in the comparison group. There were no significant differences between the intervention and comparison groups in the other measures, posttest math concepts and total math scores.

Cautions

The sample sizes for the matched sample in study three were small, thereby making inferences problematic. Since the analysis was done at the student level while the level of intervention assignment was done at the classroom level, caution should be used in interpreting the results.

Table 1. Pretest Characteristics of the Study Sample (Study Three Matched Sample Only)

	Intervention (*n* = 39)	Comparison (*n* = 39)
Grade 8	39	39
Pretest CAT Total Math Score	51.7	51.7
Pretest CAT Math Computation Score	50.6	50.8
Pretest CAT Math Concepts Score	52.3	51.8

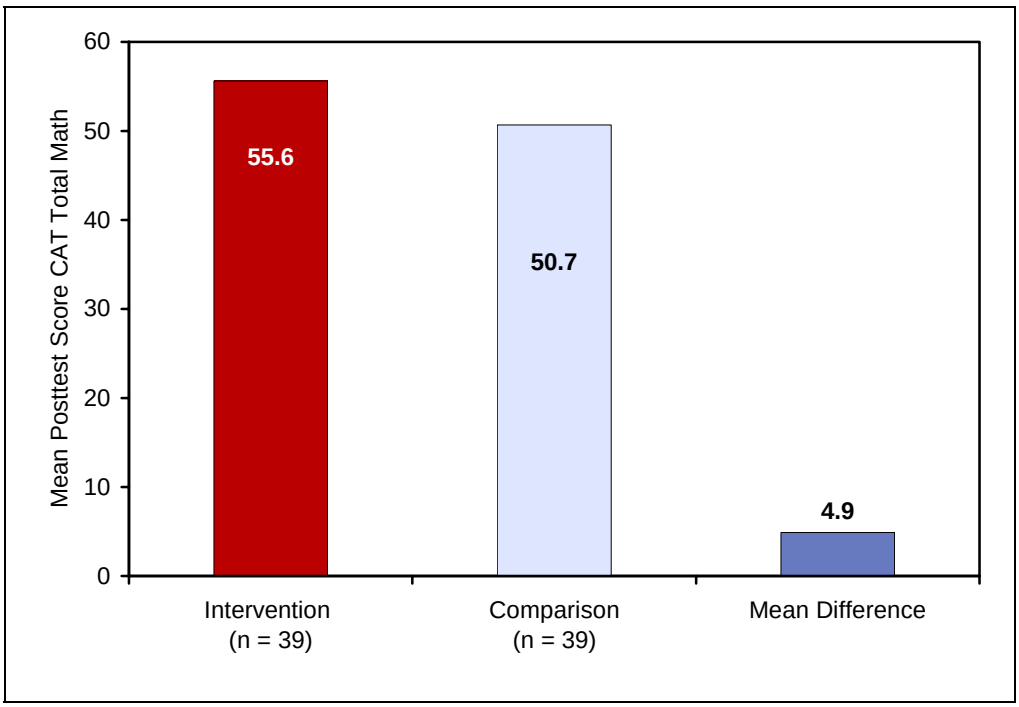
Note. Pretest characteristics are reported at the student level (this is the unit of analysis utilized by Crawford and Raia) for the matched sample within study three only (this is the only relevant analysis for the WWC study report). Crawford and Raia assigned to the intervention and comparison groups at the level of the class. CAT = California Achievement Test.

Table 2. Impact Reported by Crawford and Raia (1986): CAT Total Math, Math Computation, and Math Concepts Posttest Scores

	Intervention (*n* = 39)	Comparison (*n* = 39)
Total Math		
Mean (*SD*)	55.6 (11.9)	50.7 (11.8)
Sample Size	39	39
Math Computation		
Mean (*SD*)	57.6 (13.4)	51.5 (14.1)
Sample Size	39	39
Math Concepts		
Mean (*SD*)	53.4 (12.4)	49.8 (12.4)
Sample Size	39	39

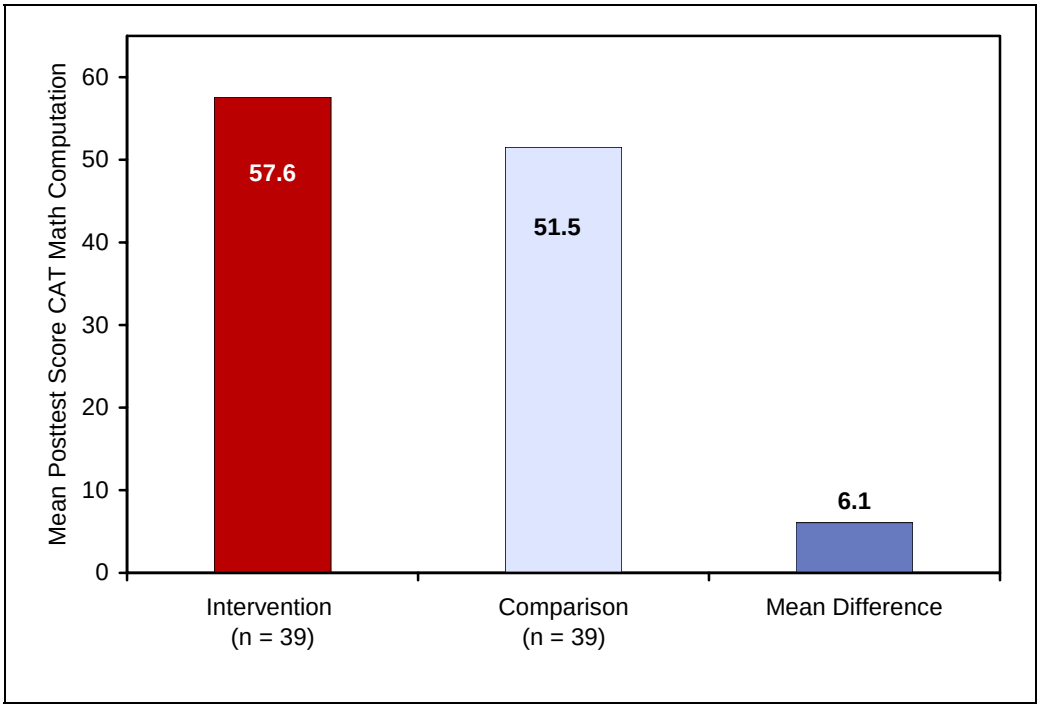
Note. These are posttest score results for the CAT total math, math computation, and math concepts tests calculated at the level of the student by Crawford and Raia (1986). CAT = California Achievement Test.

Figure 1a. Impact Calculated by Crawford and Raia (1986): CAT Total Math Posttest Scores



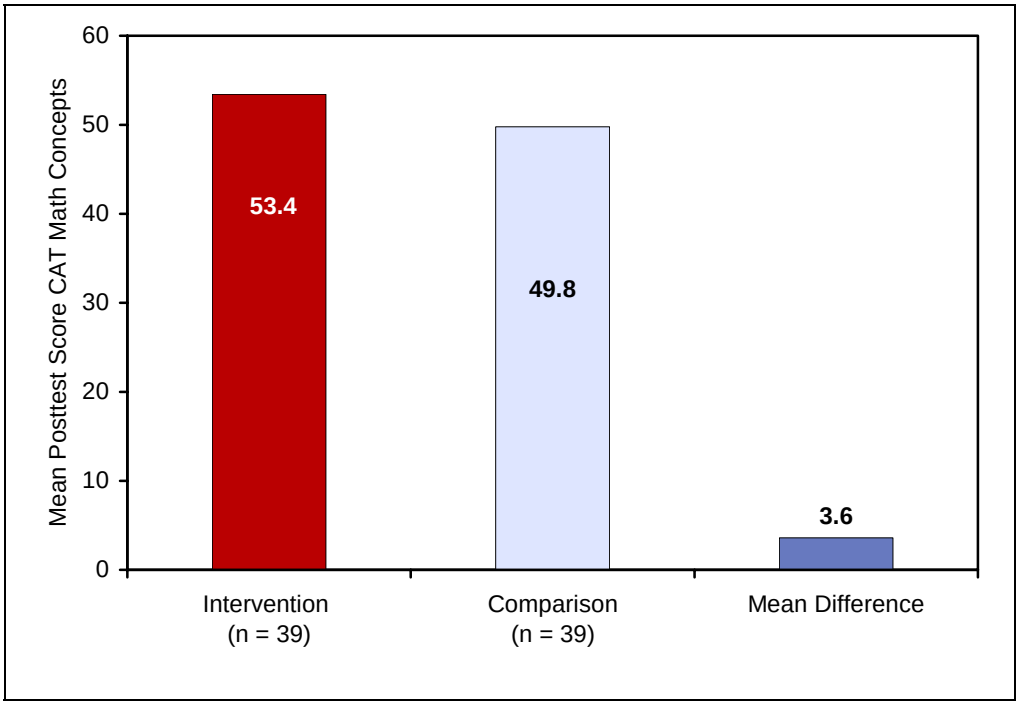
Note. The analyses are done at the level of the student, which does not match the unit of assignment (class). Crawford and Raia (1986) reported that the intervention group posttest scores did not differ significantly from the comparison group posttest scores (*p* = ns). CAT = California Achievement Test.

Figure 1b. Impact Calculated by Crawford and Raia (1986): CAT Math Computation Posttest Scores



Note. The analyses are done at the level of the student, which does not match the unit of assignment (class). Crawford and Raia (1986) reported that the intervention group posttest scores were significantly higher than the comparison group posttest scores (p = .05). CAT = California Achievement Test.

Figure 1c. Impact Calculated by Crawford and Raia (1986): CAT Math Concepts Posttest Scores



Note. The analyses are done at the level of the student, which does not match the unit of assignment (class). Crawford and Raia (1986) reported that the intervention group scores did not differ significantly from the comparison group scores (*p* = ns). CAT = California Achievement Test.

Intervention Developer Contact Information

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Related Studies

See reports on other studies of Saxon Math.

See reports on other studies of Middle School Math curricula.

Report Production

Date created: March 4, 2005

Topic area reviewed under: Curriculum-Based Interventions for Increasing K-12 Math Achievement—Middle School

WWC Study Ratings[a]: Crawford and Raia (1986)

Causal Validity: Meets WWC Evidence Standards, a Quasi-Experimental Design with Stratified Matching

Students in the intervention group (*Saxon Algebra 1/2*) were compared to students in the comparison group (Scott-Foresman Mathematics). It is not clear how teachers and students were identified for the study or how they were placed in groups other than that classes that implemented *Saxon Algebra 1/2* seemed to be a convenience sample. This study report focuses on the matched sample within study three. Crawford and Raia matched the students who were in the classes where the teachers taught both curricula on pretest California Achievement Test (CAT) total math scores and compared the posttest total math, math computation, and math concepts scores between groups. There does not appear to be attrition at the level of assignment or analysis within this subsample. Crawford and Raia do not report any extraneous events that might have confounded the intervention's effects.

Other Study Characteristics	Study Rating	Study-Specific Information
Intervention Fidelity	●	*Saxon Math* meets the definition of Middle School Math. However, Crawford and Raia do not provide information about the implementation of the program. There was no measure of teacher implementation, and teacher training was not discussed.
Outcome Measures	●●	One achievement measure was reported in the study, the CAT, a test of basic skills including math computation and math concepts. The CAT is a nationally normed, standardized test, has acceptable reliability and validity, and appears to align to the intervention.
People, Settings, and Timing	●	Although the sample of students is part of the identified middle school math population, it was homogeneous with respect to students (no subgroup variation) and settings. The outcome measure was implemented at a time appropriate to capture the effect of the intervention, but there was no variation in the type of achievement measure.
Testing within Subgroups	●	The effect of *Saxon Algebra 1/2* on students' mathematics achievement was tested across the entire matched sample, but was not tested within subgroups of the sample or variations across settings.
Analysis	●	The unit of assignment (class) was not the same as the unit of analysis (student). The statistical properties of the data allowed for valid estimates of effect sizes, but sample sizes were not adequate to provide sufficiently precise estimates of effect sizes. The sample sizes were small for the matched sample in this study, making inferences problematic.
Statistical Reporting	●●	Sufficient data were reported, but they were reported at the level of the student. Crawford and Raia reported unadjusted means and standard deviations. Effect sizes for the outcome measure could be calculated using a standard formula if means and standard deviations were reported at the level of the teacher for the matched sample in study three.

Note. ●● Fully meets criteria; ● Meets minimum criteria; **X** Does not meet criteria.

[a] For more information on the criteria used to rate this study, see the WWC Evidence Standards: Middle-School Math.