What Works Clearinghouse

ies INSTITUTE OF EDUCATION SCIENCES

University of Chicago School Mathematics Project (UCSMP) Algebra

Program Description[2]

University of Chicago School Mathematics Project (UCSMP) Algebra is a one-year course covering three primary topics: (1) linear and quadratic expressions, sentences, and functions; (2) exponential expressions and functions; and (3) linear systems. Topics from geometry, probability, and statistics are integrated with the appropriate algebra. Problem-solving and real-world applications are used throughout to develop and maintain basic skills and concepts. Computer algebra system (CAS) technology is used in the classroom to aid in the development of properties and skills, and graphing calculators are used to complete assignments at home.

Research

One study of *UCSMP Algebra* meets the What Works Clearinghouse (WWC) evidence standards with reservations. The study includes 36 eighth-grade students in a Nebraska junior high school. This study used the first edition of *UCSMP Algebra* as the intervention.[3]

Based on this one study, the WWC considers the extent of evidence for *UCSMP Algebra* to be small for the math achievement domain.

Effectiveness

UCSMP Algebra was found to have no discernible effects on math achievement.

	Math achievement
Rating of effectiveness	No discernible effects
Improvement index[4]	Average: –6 percentile points

1. This report has been updated from the previous version (posted March 26, 2007) to include reviews of 10 studies that have been released since 2005. All 10 studies are not within the scope of the protocol. A complete list and disposition of all studies reviewed is provided in the references. Additionally, one study that met standards with reservations in the previous version (Thompson, Senk, Witonsky, Usiskin, & Kaeley, 2006) will now be eligible for review as part of the WWC high school math topic area. (The protocol for the middle school math topic area was revised to narrow the scope from examining any 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.)
2. The descriptive information for this program was obtained from a publicly available source: the program's website (https://www.wrightgroup.com/ucsmp/index.html?PHPSESSID=50e67838d5e498ac7fed20fc7acf10ea&gid=228, downloaded August 2008). 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 evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.
4. These numbers show the average student-level improvement indices for all findings across the study.

Additional program information

Developer and contact

Developed by the University of Chicago School Mathematics Project, *UCSMP Algebra* is distributed by the Wright Group/McGraw-Hill. Address: 220 East Danieldale Road, DeSoto, TX 75115. Email: WrightGroup@McGraw-Hill.com. Web: https://www.wrightgroup.com/ucsmp/index.html?PHPSESSID=50e67838d5e498ac7fed20fc7acf10ea&gid=228. Telephone: (800) 523-2371.

Scope of use

The first edition of *UCSMP Algebra* was developed and tested between 1985 and 1988, and the second edition was developed and tested between 1992 and 1994. The third edition was developed and tested between 2005 and 2007 and is now available through the Wright Group/McGraw-Hill. According to the developers at the University of Chicago, 3.5 to 4 million students in elementary, middle, and high schools are currently using *UCSMP* materials and curricula. The number of students using only *UCSMP Algebra* is not available.

Teaching

The *UCSMP Algebra* course includes the student book, teacher's edition book and teacher resources, assessment resources, and technology resources. Almost all lessons in the student book contain activities, full examples, guided examples, and "quiz yourself" questions to create a more active classroom. Questions in each lesson cover the lesson concepts, extensions and applications of those concepts, and previous lessons. The teacher's edition book contains additional examples as well as suggestions for differentiation to accommodate the broad population of students in algebra courses. Computer algebra system (CAS) technology is used in the classroom to aid in the development of properties and skills, and graphing calculators are used to complete assignments at home.

Cost

A student textbook costs $63.00. A bundled, complete teacher resource package consisting of the Teacher's Edition (Volumes 1 & 2), Teacher's Resources (Volumes 1 & 2), Assessment CD Rom, and "eTe with Answers and Solutions" (Volumes 1 & 2) costs $346.50. See the publisher's website for pricing of individual teacher resource items.

Research

Thirteen studies reviewed by the WWC investigated the effects of *UCSMP Algebra*. One study (Peters, 1992) is a randomized controlled trial with randomization problems that meets WWC evidence standards with reservations. The remaining 12 studies do not meet either WWC evidence standards or eligibility screens.

Meets evidence standards with reservations

Peters (1992) conducted a randomized controlled trial design with randomization problems.[5] The study's sample included 36 "math-talented" students from one junior high school in Nebraska.[6] Most of the students were Caucasian. The district borders two large cities (Lincoln and Omaha) and has a mix of students living in rural and suburban locations. Students in the intervention group used the *UCSMP Algebra* first edition textbook, while students in the comparison group used the *Saxon Middle School Math* curriculum.

Extent of evidence

The WWC categorizes the extent of evidence in each domain as small or medium to large (see the What Works Clearinghouse

5. Peters (1992) compared *UCSMP Algebra* with *Saxon Middle School Math*. 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.
6. 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)*

Extent of Evidence Categorization Scheme). 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.[7]

The WWC considers the extent of evidence for *UCSMP Algebra* to be small for math achievement.

Effectiveness

Findings

The WWC review of middle school math curricula addresses student outcomes in the math achievement domain. The findings below present the author's estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *UCSMP Algebra* on students.[8]

Peters (1992) reported no statistically significant differences in Orleans-Hanna Algebra Prognosis test scores between the *UCSMP Algebra* group and the *Saxon Middle School Math* group. Further, the effect size was neither statistically significant nor large enough to be considered substantively important by WWC criteria (at least 0.25).

In sum, one study of *UCSMP Algebra*, first edition, showed an indeterminate effect.

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 (as calculated by the WWC), the size of the difference between participants in the intervention and the comparison conditions, and the consistency in findings across studies (see the WWC Intervention Rating Scheme).

The WWC found *UCSMP Algebra* to have no discernible effects on 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 Technical Details of WWC-Conducted Computations). The improvement index represents the difference between the percentile rank of the average student in the intervention condition versus 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 results favorable to the intervention group.

The average improvement index for math achievement is –6 percentile points in the study.

Summary

The WWC reviewed 13 studies on *UCSMP Algebra*. One of these studies meets WWC evidence standards with reservations; the remaining 12 studies do not meet either WWC evidence standards or eligibility screens. Based on this one study, the WWC found no discernible effects on students' math achievement. The conclusions presented in this report may change as new research emerges.

7. 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 *UCSMP Algebra* is in Appendix A5.
8. 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 Technical Details of WWC-Conducted Computations. In the case of Peters (1992), no correction for clustering or multiple comparisons was needed.

References

Meets WWC evidence standards with reservations

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)

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

Davis, J. D., & Shih, J. C. (2007). Secondary options and post-secondary expectations: Standards-based mathematics programs and student achievement on college mathematics placement exams. *School Science and Mathematics, 107*(8), 336–346. This study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Fan, L., & Zhu, Y. (2007). Representation of problem-solving procedures: A comparative look at China, Singapore, and U.S. mathematics textbooks. *Educational Studies in Mathematics, 66*(1), 61–75. This study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Herbel-Eisenmann, B. A., Lubienski, S. T., & Id-Deen, L. (2006). Reconsidering the study of mathematics instructional practices: The importance of curricular context in understanding local and global teacher change. *Journal of Mathematics Teacher Education, 9*(4), 313–345. This study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Lee, K. (2005). Student conceptual understanding and application on algebra-problem-based curricula. *Research in Mathematical Education, 9*(2), 125–133. This study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Mathison, S., Hedges, L. V., Stodolsky, S., Flores, P., & Sarther, C. (1989). *Teaching and learning algebra: An evaluation of UCSMP Algebra* (Evaluation Rep. No. 88/89-ALG-1). Chicago: University of Chicago. This study is ineligible for review because it does not disaggregate findings for the age or grade range specified in the protocol.

Thompson, D. R., & Senk, S. L. (2006). Methods for controlling for opportunity-to-learn. *Conference Papers—Psychology of Mathematics & Education of North America, 2,* 179–186. This study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Thompson, D. R., Senk, S. L., Witonsky, D., Usiskin, Z., & Kaeley, G. (2006). *An evaluation of the second edition of UCSMP Algebra.* Chicago: University of Chicago School Mathematics Project. This study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

UCSMP. (2007). Fidelity of implementation in the UCSMP secondary component. *UCSMP Newsletter,* 9. This study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

UCSMP. (2007). Opportunity to learn: A critical variable in UCSMP curriculum research. *UCSMP Newsletter,* 3–6. This study is ineligible for review because it is not a primary analysis of the effectiveness of an intervention.

Wood, F. R. (2006). *The relationship between the measured changes in mathematics scores of eighth grade New Jersey students and the implementation of a standards-based mathematics program.* Unpublished doctoral dissertation, Widener University, Chester, PA. This study is ineligible for review because it does not use a comparison group.

Zahrt, L. T. (2001). *School reform math programs: An evaluation for leaders.* Unpublished doctoral dissertation, Eastern Michigan University, Ypsilanti, MI. This study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Zhu, Y., & Fan, L. (2006). Focus on the representation of problem types in intended curriculum: A comparison of selected mathematics textbooks from mainland China and the United States. *International Journal of Science and Mathematics Education, 4*(4), 609–626. This study is ineligible for review because it does not take place in the geographic area specified in the protocol.

For more information about specific studies and WWC calculations, please see the WWC *UCSMP Algebra* Technical Appendices.

Appendix

Appendix A1 Study Characteristics: Peters, 1992 (randomized controlled trial with randomization problems)

Characteristic	Description
Study citation	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)
Participants	The study included 36 students in grade 8 in two classrooms in one school during the 1991/92 school year. All of the students were "math-talented" 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. The sample consisted of 20 girls (9 treatment, 11 comparison) and 16 boys (8 treatment, 8 comparison).
Setting	The study took place in one junior high school in Nebraska. The district borders two large cities (Lincoln and Omaha) and has a mix of students living in rural and suburban locations. Students were randomly assigned to one of two classrooms (one intervention classroom and one comparison classroom).[1] The same teacher taught both the intervention and comparison groups.
Intervention[2]	Participants in the intervention group were taught the *UCSMP Algebra* curriculum during the 1991/92 school year. The intervention curriculum was monitored weekly by the researcher to help maintain fidelity of implementation.
Comparison	Participants in the comparison group were taught using the *Saxon Middle School Math* curriculum for eighth-grade students (Algebra 1/2). Students in this group participated in daily sessions for one academic year. In each session, the teacher introduced a new concept incrementally, and students had opportunities to practice the new concept and past concepts during each session. Students were assessed every fifth lesson. The *Saxon Math* curriculum is designed to cover 120 lessons in one year.
Primary outcomes and measurement	The primary outcome measure is the Orleans-Hanna Algebra Prognosis Test.[3] The pretest administration occurred in August 1991, and the posttest administration occurred in May 1992. For a more detailed description of this outcome measure, see Appendix A2.
Staff/teacher training	The study noted that the teacher who taught both study groups did not have prior experience with the intervention or comparison curricula but had read extensively about both teaching formats. The teacher participated in a one-week summer workshop on *UCSMP Algebra*, and in two additional one-day workshops given by local consultants on the curricula used in this study. Further, agreed-upon components of both the intervention and comparison curricula were monitored on a weekly basis by the researcher to help maintain the integrity of implementation.

1. 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. The analysis sample includes 17 students in the *UCSMP Algebra* group and 19 in the *Saxon Math* group. The study author demonstrated the baseline equivalence of the *UCSMP Algebra* and *Saxon Math* groups at pretest.
2. The same teacher taught both the intervention and comparison groups. Because both the intervention and comparison curricula were monitored on a weekly basis by the researcher to help maintain the integrity of implementation, and because there is no indication in the study to assume that the teacher was biased toward one of the conditions, this design was accepted for review.
3. The author described only the Orleans-Hanna Algebra Prognosis Test as the measure of student math achievement. The study also examined four study-generated criterion unit tests, not from the Orleans-Hanna Algebra Prognosis Test, designed to descriptively measure student understanding of algebraic components. However the author did not provide information on the reliability or validity of these four tests. Accordingly, analyses based on these four unit tests were not considered in this version of the report.

Appendix A2 Outcome measure for the math achievement domain

Outcome measure	Description
Orleans-Hanna Algebra Prognosis Test	This nationally normed test consists of 60 multiple-choice items based on nine model lessons and five questionnaire items that require students to report their course grades and predict their final grade if they were to take algebra. In contrast to an achievement test, students are required to answer questions by following a procedure or set of operations using mathematical or verbal expressions parallel to but different from those contained in the model lessons. This test is often used to predict the ability to succeed in a first-year algebra course (as cited in Peters, 1992). For Peters (1992), pretest scores on the Orleans-Hanna Prognosis Test were from an August 1991 administration and posttest scores were from a May 1992 administration.

Appendix A3 Summary of study findings included in the rating for the math achievement domain[1]

Outcome measure	Study sample	Sample size (classrooms/ students)	Authors' findings from the study: Mean outcome (standard deviation)[2] — *UCSMP Algebra* group	Authors' findings from the study: Mean outcome (standard deviation)[2] — Comparison group	WWC calculations: Mean difference[3] (*UCSMP Algebra*-comparison)	WWC calculations: Effect size[4]	WWC calculations: Statistical significance[5] (at $\alpha = 0.05$)	WWC calculations: Improvement index[6]
Peters, 1992 (randomized controlled trial with randomization problems)[7]								
Orleans-Hanna Algebra Prognosis Test	Grade 8 (math-talented)	2/36	95.02[8] (4.09)	95.63[9] (4.53)	–0.61	–0.14	ns	–6
Average for math achievement (Peters, 1992)[10]						**–0.14**	**ns**	**–6**
Domain average for math achievement across all studies[10]						**–0.14**	**ns**	**–6**

ns = not statistically significant

1. This appendix reports findings considered for the effectiveness rating and the average improvement indices for the math achievement domain.
2. The standard deviation across all students in each group shows how dispersed the participants' outcomes are: a smaller standard deviation on a given measure would indicate that participants had more similar outcomes.
3. Positive differences and effect sizes favor the intervention group; negative differences and effect sizes favor the comparison group.
4. For an explanation of the effect size calculation, see Technical Details of WWC-Conducted Computations.
5. Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups.
6. The improvement index represents the difference between the percentile rank of the average student in the intervention condition and that of the average student in the comparison condition. The improvement index can take on values between –50 and +50, with positive numbers denoting results favorable to the intervention group.
7. The level of statistical significance was reported by the study author or, where necessary, calculated by the WWC to correct for clustering within classrooms or schools and for multiple comparisons. For an explanation about the clustering correction, see the WWC Tutorial on Mismatch. For the formulas the WWC used to calculate statistical significance, see Technical Details of WWC-Conducted Computations. In the case of Peters (1992), no correction for clustering or multiple comparisons was needed.
8. The intervention group value from Peters (1992) is the comparison group mean plus the difference in mean gains between the intervention (*UCSMP Algebra*) and control groups.
9. The comparison group mean from Peters (1992) is unadjusted.
10. The WWC-computed average effect sizes for each study and for the domain across studies are simple averages rounded to two decimal places. The average improvement indices are calculated from the average effect sizes.

Appendix A4 *UCSMP Algebra* rating for the math achievement domain

The WWC rates an intervention's effects for a given outcome domain as positive, potentially positive, mixed, no discernible effects, potentially negative, or negative.[1]

For the outcome domain of math achievement, the WWC rated *UCSMP Algebra* as having no discernible effects.

Rating received

No discernible effects: No affirmative evidence of effects.

- Criterion 1: None of the studies shows a statistically significant or substantively important effect, either *positive* or *negative.*

  Met. No studies showed statistically significant or substantively important positive or negative effects.

Other ratings considered

Positive effects: Strong evidence of a positive effect with no overriding contrary evidence.

- Criterion 1: Two or more studies showing statistically significant *positive* effects, at least one of which met WWC evidence standards for a *strong* design.

  Not met. No studies showed statistically significant positive effects.

AND

- Criterion 2: No studies showing statistically significant or substantively important *negative* effects.

  Met. No studies showed statistically significant or substantively important negative effects.

Potentially positive effects: Evidence of a positive effect with no overriding contrary evidence.

- Criterion 1: At least one study showing a statistically significant or substantively important *positive* effect.

  Not met. No studies showed a statistically significant or substantively important positive effect.

AND

- Criterion 2: No studies showing a statistically significant or substantively important *negative* effect and fewer or the same number of studies showing *indeterminate* effects than showing statistically significant or substantively important *positive* effects.

  Not met. The study that evaluated math achievement and met WWC standards with reservations showed indeterminate effects.

Mixed effects: Evidence of inconsistent effects as demonstrated through EITHER of the following criteria.

- Criterion 1: At least one study showing a statistically significant or substantively important *positive* effect, and at least one study showing a statistically significant or substantively important *negative* effect, but no more such studies than the number showing a statistically significant or substantively important *positive* effect.

  Not met. No studies showed a statistically significant or substantively important effect, either positive or negative.

OR

- Criterion 2: At least one study showing a statistically significant or substantively important effect, and more studies showing an *indeterminate* effect than showing a statistically significant or substantively important effect.

  Not met. No studies showed statistically significant or substantively important effects, either positive or negative.

1. For rating purposes, the WWC considers the statistical significance of individual outcomes and the domain-level effect. The WWC also considers the size of the domain-level effect for ratings of potentially positive or potentially negative effects. For a complete description, see the WWC Intervention Rating Scheme.

Appendix A5 Extent of evidence by domain

Outcome domain	Number of studies	Sample size		Extent of evidence[1]
		Schools	Students	
Math achievement	1	1	36	Small

1. A rating of "medium to large" requires at least two studies and two schools across studies in one domain, and a total sample size across studies of at least 350 students or 14 classrooms. Otherwise, the rating is "small."