

What Works Clearinghouse



Core-Plus Mathematics

Program Description¹

Core-Plus Mathematics is a four-year curriculum that replaces the traditional sequence with courses that each feature interwoven strands of algebra and functions, statistics and probability, geometry and trigonometry, and discrete mathematics. The first three courses in the series provide a common core of broadly useful mathematics, while the fourth continues the preparation of students for college mathematics and statistics courses. The curriculum emphasizes mathematical modeling, using

technology to emphasize reasoning with multiple representations (verbal, numerical, graphical, and symbolic) and to focus on goals in which mathematical thinking and problem solving are central. Instructional materials promote active learning and teaching centered around collaborative small-group investigations of problem situations, followed by teacher-led whole-class summarizing activities that lead to analysis, abstraction, and further application of underlying mathematical ideas.

Research²

One study of *Core-Plus Mathematics* that falls within the scope of the High School Mathematics review protocol meets What Works Clearinghouse (WWC) evidence standards with reservations. The one study included 1,050 high school students in 11 schools in multiple states.³

Based on the one study, the WWC considers the extent of evidence for *Core-Plus Mathematics* on high school students to be small for math achievement.

1. The descriptive information for this program was obtained from publicly available sources: the program's website (<http://www.wmich.edu/cpmp>, downloaded June 2010) and Schoen and Hirsch (2002). 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 March 2010.
2. The studies in this report were reviewed using WWC Evidence Standards, Version 2.0 (see the WWC Procedures and Standards Handbook, Chapter III), as described in protocol Version 2.0.
3. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.

Effectiveness *Core-Plus Mathematics* was found to have potentially positive effects on mathematics achievement for high school students.

	Mathematics achievement
Rating of effectiveness	Potentially positive effects
Improvement index⁴	Average: +15 percentile points Range: -15 to +36 percentile points

Additional program information

Developer and contact

Developed by the Core-Plus Mathematics Project (CPMP) at Western Michigan University, *Core-Plus Mathematics* is distributed by Glencoe/McGraw-Hill. Email: cpmp@wmich.edu. Web: <http://www.wmich.edu/cpmp>. Telephone: (866) 407-2767.

Scope of use

This review is restricted to the first edition of *Core-Plus Mathematics*, published under the title *Contemporary Mathematics in Context*, with copyright dates of 2003 and earlier. Courses in the first edition were field tested beginning in 1994. The second edition of *Core-Plus Mathematics* has copyright dates of 2008 and later.

Teaching

Core-Plus Mathematics units are designed around multi-day lessons organized around cycles of instructional activities intended primarily for small-group work in the classroom and for individual work outside of the classroom. Lessons begin with a full-class discussion of a problem situation and related questions to think

about in which the teacher is director and moderator. Classroom activity then shifts to investigating focused problems and questions related to the launching situation by gathering data, looking for patterns, constructing models and meanings, and making and verifying conjectures, with the teacher acting as facilitator. A full-class discussion (referred to as a Checkpoint) of concepts and methods developed by different small groups then provides an opportunity to share progress and thinking, with the teacher acting as moderator. Finally, students are given a task related to lesson objectives to complete on their own, while the teacher serves as an intellectual coach. In addition to the classroom investigations, *Core-Plus Mathematics* provides sets of MORE tasks, which are designed to engage students in Modeling with, Organizing, Reflecting on, and Extending their mathematical understanding in individual work outside of class.

Cost

According to the publisher's website (<http://www.mhprofessional.com>), the student edition of the textbook for each course costs approximately \$88.

Research

Seventeen studies reviewed by the WWC investigated the effects of *Core-Plus Mathematics* on high school students. One study is a quasi-experimental design that meets WWC evidence standards with reservations. The remaining 16 studies do not meet either WWC evidence standards or eligibility screens.

Meets evidence standards with reservations

Schoen and Hirsch (2002) conducted a quasi-experiment using a student matched-pairs design in 11 high schools that volunteered to administer pretests and posttests to students in *Core-Plus Mathematics* and traditional classrooms. The 11 schools were drawn from a larger group of 36 schools that were field testing the *Core-Plus*

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

Research (continued) *Mathematics* curriculum. Students in comparison classrooms were grouped by their most recently completed math course, and then matched to students in the intervention group using pretest score, school, and gender, in that order. This process was conducted separately during each of the two years of the study, though only five of the 11 schools from year one agreed to posttest students in the comparison group in year two. The main analysis included 1,050 students (525 intervention and 525 comparison) in year one and 390 students (195 intervention and 195 control) in year two. Additional analyses varied in sample size, with baseline equivalence information presented separately for each of these samples.

Effectiveness Findings

The WWC review of interventions for High School Mathematics addresses student outcomes in one domain: mathematics achievement. The findings below present the authors' estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *Core-Plus Mathematics* on high school students.⁶

Mathematics achievement. Schoen and Hirsch (2002) reported positive and statistically significant effects of *Core-Plus Mathematics* on the Iowa Tests of Educational Development mathematics subtest in ninth grade, all three subtests of the Course 1 CPMP Posttest in ninth grade, and contextual algebra and coordinate geometry subtests of the Course 2 CPMP Posttest in tenth grade; these were confirmed by the WWC after adjustments were made for clustering and multiple comparisons. The study also reported a positive, though not statistically significant, effect on SAT math scores; this finding was large enough to be considered

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.⁵

The WWC considers the extent of evidence for *Core-Plus Mathematics* to be small for mathematics achievement for high school students.

substantively important according to WWC criteria (i.e., an effect size of at least 0.25). As the finding for at least one measure within the domain is positive and statistically significant, and no effects are negative and statistically significant, accounting for clustering and multiple comparisons, this study is characterized by the WWC as having a statistically significant positive 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, 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).

5. 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 *Core-Plus Mathematics* is in Appendix A6.
6. 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 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. In the case of Schoen and Hirsch (2002), corrections for clustering and multiple comparisons were needed, so the significance levels may differ from those reported in the original study.

**The WWC found
Core-Plus Mathematics to
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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 mathematics achievement is +15 percentile points in the one study, with a range of -15 to +36 percentile points across findings.

Summary

The WWC reviewed 17 studies on *Core-Plus Mathematics* for high school students. One of these studies meets WWC evidence standards with reservations; the remaining 16 studies do not meet either WWC evidence standards or eligibility screens. Based on the one study, the WWC found potentially positive effects on mathematics achievement for high school students. The conclusions presented in this report may change as new research emerges.

References

Meets WWC evidence standards with reservations

Schoen, H. L., & Hirsch, C. R. (2002). The *Core-Plus Mathematics* project: Perspectives and student achievement. In S. Senk & D. Thompson (Eds.), *Standards-based school mathematics curricula: What are they? What do students learn?* (pp. 311–343). Hillsdale, NJ: Lawrence Erlbaum Associates.

Additional source:

Schoen, H. L., Hirsch, C. R., & Ziebarth, S. W. (1998). *An emerging profile of the mathematical achievement of students in the Core-Plus Mathematics project*. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

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

Fey, J., & Hirsch, C. (2007). The case of *Core-Plus Mathematics*. In C. Hirsch (Ed.), *Perspectives on the design and development of school mathematics curricula*. Reston, VA: National Council of Teachers of Mathematics. The study is ineligible for review because it does not examine the effectiveness of an intervention.

Fey, J., Hirsch, C., & Schoen, H. (2007). The future of high school mathematics: New priorities and promising innovations. *Michigan Section MAA Newsletter*, 34, 10–14. The study is ineligible for review because it does not examine the effectiveness of an intervention.

Fey, J. T., Hirsch, C. R., Hart, E., Schoen, H., & Watkins, A. (2007). Editor's endnotes. *American Mathematical Monthly*, 114(7), 654–656. The study is ineligible for review because it does not examine the effectiveness of an intervention.

Hirsch, C. R., & Schoen, H. (2002). *Developing mathematical literacy: A Core-Plus Mathematics project longitudinal study progress report*. Unpublished manuscript. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.

Huntley, M. A. (2000). Effects of standards-based mathematics education: A study of the *Core-Plus Mathematics* project algebra and functions strand. *Journal for Research in Mathematics Education*, 31(3), 328. The study does not meet WWC evidence standards because it uses a quasi-experimental

References (continued)

- design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Latterell, C. M. (2003). Testing the problem-solving skills of students in an NCTM-oriented curriculum. *The Mathematics Educator*, 13(1), 5–14. The study is ineligible for review because it does not examine the effectiveness of an intervention.
- Mariano, T. (n.d.). *A randomized control group study of student achievement on the New York State Mathematics A Regents High School examination*. Retrieved from http://www.wmich.edu/cpmp/pdfs/CPMP_Achievement_lthaca.pdf. The study is ineligible for review because it does not provide enough information about its design to assess whether it meets standards.
- Nelson, R. (2005). *A matched study of Washington state 10th grade assessment scores of students in schools using the Core-Plus Mathematics program*. Retrieved from http://www.wmich.edu/cpmp/pdfs/CPMP_Achievement_WA_22Schools.pdf. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Schoen, H., Ziebarth, S., Hirsch, C., & Lorenz, A. B. (2010). *A five-year study of the first edition of the Core-Plus Mathematics curriculum*. Charlotte, NC: Information Age Publishing. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Schoen, H. L., Cebulla, K. J., & Winsor, M. S. (2001). *Preparation of students in a standards-oriented mathematics curriculum for college entrance tests, placement tests, and beginning mathematics courses*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Schoen, H. L., & Hirsch, C. R. (2003). Responding to calls for change in high school mathematics: Implication for collegiate mathematics. *American Mathematical Monthly*, 110(2), 109–123. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Stucki, J. (2006). *Wayzata High School, Plymouth, MN Mathematics program evaluation*. Retrieved from http://www.wmich.edu/cpmp/pdfs/CPMP_Achievement_Wayzata.pdf. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Tauer, S. (n.d.). *How does the use of two different mathematics curricula affect student achievement? A comparison study in Derby, Kansas*. Retrieved from http://www.wmich.edu/cpmp/pdfs/CPMP_Achievement_Derby.pdf. The study does not meet WWC evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.
- Verkaik, M. (2007). *CPMP student performance at Holland Christian High School*. Retrieved from http://www.wmich.edu/cpmp/pdfs/CPMP_Achievement_Holland.pdf. The study is ineligible for review because it does not use a comparison group design or a single-case design.
- Walker, R. K. (1999). *Students' conceptions of mathematics and the transition from a standards-based reform curriculum to college mathematics*. Unpublished doctoral dissertation, Western Michigan University, Kalamazoo. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.
- Zahrt, L. T. (2001). *School reform math programs: An evaluation for leaders*. Unpublished doctoral dissertation, Eastern Michigan University, Ypsilanti. The study does not meet evidence standards because it uses a quasi-experimental design in which the analytic intervention and comparison groups are not shown to be equivalent.