What Works Clearinghouse™

ies INSTITUTE OF EDUCATION SCIENCES

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WWC Review of the Report "The Effects of POWERSOURCE© Intervention on Student Understanding of Basic Mathematical Principles"[1]

The findings from this review do not reflect the full body of research evidence on *POWERSOURCE*©.

What is this study about?

The study examined the impact of *POWERSOURCE*©, an intervention consisting of formative assessments, instructional resources, and professional development designed to help teachers provide individual instruction to their students in Algebra I. This study took place in seven districts in Arizona and California during the 2007–08 school year.

The design for this study used two different types of randomization. In three districts, 26 sixth-grade teachers were randomly assigned to use *POWERSOURCE*© and 23 other sixth-grade teachers to a comparison group. In the four remaining districts, researchers randomly assigned 17 schools either to use *POWERSOURCE*© or to be in the comparison condition.

The *POWERSOURCE*© intervention targets four domains: (a) rational number equivalence, (b) properties of arithmetic, (c) principles for solving linear equations, and (d) applications of core principles. Teachers in the intervention condition used approximately eight class periods (two per domain) for student assessment and instruction with *POWERSOURCE*©. Three assessments were used for each domain. In addition to the formative assessments, the *POWERSOURCE*© intervention included resources for teachers that explained the results of the assessments and how they could be used to increase student learning. Teachers in the comparison condition were offered a different (non-*POWERSOURCE*©) professional development program from the National Center for Research on Evaluation, Standards, and Student Testing.

Researchers assessed the effectiveness of *POWERSOURCE*© by comparing student performance on a mathematics achievement test. Results were presented for a composite score and for the three subscales that comprise the main achievement outcome. The outcomes assessed dimensions of student performance in algebra and were constructed from a range of national, state, and local assessments.

WWC Rating

The research described in this report for the sample that randomly assigned teachers to condition meets WWC evidence standards without reservations

Strengths: The study includes a well-implemented randomized controlled trial of teachers with low levels of sample attrition for the main outcome and the three subscale outcomes (properties of arithmetic, rational number equivalence, and solving equations).

Cautions: The research on the sample that randomly assigned schools to condition does not meet WWC evidence standards because there were high levels of attrition, and the analytic samples were not demonstrated to be equivalent at baseline.

What did the study find?

The study reported that students of teachers who were assigned to use the *POWERSOURCE*© intervention performed better on questions about properties of arithmetic. The WWC did not confirm this finding to be statistically significant after adjusting for the clustering of students within teachers as the unit of assignment.

Features of *POWERSOURCE*©

POWERSOURCE© is an intervention consisting of formative assessments, instructional resources, and professional development designed to help teachers provide individual instruction to their students. The *POWERSOURCE*© intervention targets four domains: (a) rational number equivalence, (b) properties of arithmetic, (c) principles for solving linear equations, and (d) applications of core principles.

Three assessments are administered in each domain to help guide instruction. The first assessment has eight to 10 items on a math concept and takes about 15–20 minutes, followed by an analysis of results and focused instruction to address problem areas identified by the assessment. The second assessment, which has four to five items, takes about 15 minutes and is followed by further instruction on applications of the concept. The third assessment, also four to five items, takes about 15 minutes and is followed by instruction, if necessary.

In addition to the formative assessments, teachers receive resources that provide explanation of the assessment results and professional development on how to use the results to inform instruction.

Appendix A: Study details

Phelan, J., Choi, K., Vendlinski T., Baker, E. L., & Herman, J. L. (2009). *The effects of POWERSOURCE© intervention on student understanding of basic mathematical principles*. *CRESST Report 763.* Los Angeles, CA: National Center for Research on Evaluation, Standards, and Student Testing, University of California, Los Angeles.

Setting

The study was conducted in one school district in Arizona and six school districts in California.

Study sample

Study authors recruited seven school districts to participate during the 2007–08 school year. Across all districts, 55% of the students were not proficient in math, and 10% to 26% of the students were English language learners. In three districts, 49 sixth-grade teachers were randomized to the intervention and comparison groups within ten schools in California. At the time of random assignment, there were 2,052 students in the intervention condition and 1,473 students in the comparison condition. The sample of students with pretest and posttest data included 1,496 students in the intervention condition and 1,120 students in the comparison condition.

In the four other districts, 17 schools were randomized within districts to the intervention and comparison groups, containing 2,078 students at the time of random assignment. The sample of students with pretest and posttest data included 842 students in the intervention schools and 633 students in the comparison schools. This WWC report considers each randomly assigned sample separately, and only the sample of schools using within-school random assignment meets WWC standards without reservations.

Intervention group

Teachers in the intervention group used approximately eight class periods for student assessment and instruction with *POWERSOURCE©*. The *POWERSOURCE©* intervention targets four domains related to success in Algebra I: (a) rational number equivalence, (b) properties of arithmetic, (c) principles for solving linear equations, and (d) applications of core principles. For each domain, three assessments were administered to help determine the content to be taught.

Comparison group

Teachers in the comparison condition were offered a different (non-*POWERSOURCE©*) professional development program.

Outcomes and measurement

The main outcome measure was administered at the beginning and end of the study year and was referred to as the transfer measure. The transfer measure was constructed with items from other assessments, including the Third International Mathematics and Science Study (TIMSS), the National Assessment of Educational Progress (NAEP), the Qualifications and Curriculum Authority (QCA) Key Stage 3 exam, the Programme for International Student Assessment (PISA), and a test from a pilot district. The transfer measure has three subscales: (a) properties of arithmetic, (b) rational number equivalence, and (c) solving equations. For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

Teachers in the intervention group were told about the study objectives and formative assessment prior to implementing *POWERSOURCE*©. They were also given suggestions for analysis of student data and how it could be used to inform instruction. Follow-up meetings were held after each of the first three *POWERSOURCE*© sessions with students. In these meetings, teachers were shown an analysis of the incorrect response patterns in an assessment of students in their district. In total, teachers received approximately nine hours of professional development to support implementation.

Reason for review

This study was identified for review by the WWC because it was supported by a grant to the University of California, Los Angeles (Principal Investigator: Eva Baker) from the National Research and Development Centers at the Institute of Education Sciences (IES).

Appendix B: Outcome measures for the mathematics achievement domain

Mathematics achievement	
Transfer measure	The transfer measure was constructed using items from several assessments, including the TIMSS, the NAEP, the QCA Key Stage 3 exam, the PISA, and a test from a pilot district. The items on the transfer measure were chosen because they were related to the topics in POWERSOURCE© but were not the same as the questions in POWERSOURCE© assessments. Cronbach's alpha for this measure is 0.86.
Properties of arithmetic	This assessment is a subscale of the transfer measure and contains five items about the distributive property in arithmetic.
Rational number equivalence	This assessment is a subscale of the transfer measure and contains 11 items about the relative magnitudes of fractions.
Solving equations	This assessment is a subscale of the transfer measure and contains 14 items about solving equations.

Appendix C: Study findings for the mathematics achievement domain

Domain and outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
Mathematics achievement								
Transfer measure	Sixth-grade students in schools using within-school random assignment	10 schools/ 2,616 students	17.54 (6.12)	17.15 (5.38)	0.39	0.07	+3	nr
Domain average for mathematics achievement						**0.07**	**+3**	**Not statistically significant**

Table Notes: For mean difference, effect size, and improvement index values reported in the table, a positive number favors the intervention group and a negative number favors the comparison group. The effect size is a standardized measure of the effect of an intervention on student outcomes, representing the change (measured in standard deviations) in an average student's outcome that can be expected if the student is given the intervention. The improvement index is an alternate presentation of the effect size, reflecting the change in an average student's percentile rank that can be expected if the student is given the intervention. The statistical significance of the study's domain average was determined by the WWC; the study is characterized as having an indeterminate effect because the effect is neither statistically significant nor substantively important. nr = not reported.

Study Notes: The study used a hierarchical linear model (HLM) to combine data from the analysis of schools using both within-school random assignment as well as between-school random assignment. The model as described does not appropriately estimate the difference in outcomes of the intervention and comparison students in the pooled sample. As a result, the WWC considers the analysis of the sample of the schools using within-school random assignment and the sample of schools using between-school random assignment separately. The analysis of the sample of schools using within-school random assignment meets WWC standards without reservations, and the analysis of the sample of schools using between-school random assignment does not meet WWC standards. Consequently, the WWC has used the unadjusted means reported in the study for all WWC calculations reported above. A correction for clustering was needed and resulted in a WWC-computed *p*-value of 0.62 for the transfer measure; therefore, the WWC does not find the result to be statistically significant. Subtest results for the transfer measure are presented in Appendix D. The WWC calculated the intervention group mean by adding the difference-in-differences adjusted estimate of the average impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttests means. Please see the WWC Procedures and Standards Handbook (version 2.1) for more information.

Appendix D: Supplemental findings by domain

Domain and outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			*p*-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
Mathematics achievement								
Properties of arithmetic	Sixth-grade students in schools using within-school random assignment	10 schools/ 2,616 students	1.39 (1.41)	1.12 (1.00)	0.27	0.22	+9	nr
Rational number equivalence	Sixth-grade students in schools using within-school random assignment	10 schools/ 2,616 students	6.45 (2.18)	6.29 (2.23)	0.16	0.07	+3	nr
Solving equations	Sixth-grade students in schools using within-school random assignment	10 schools/ 2,616 students	7.75 (2.97)	7.54 (2.81)	0.21	0.07	+3	nr

Table Notes: For mean difference, effect size, and improvement index values reported in the table, a positive number favors the intervention group and a negative number favors the comparison group. The effect size is a standardized measure of the effect of an intervention on student outcomes, representing the change (measured in standard deviations) in an average student's outcome that can be expected if that student is given the intervention. The improvement index is an alternate presentation of the effect size, reflecting the change in an average student's percentile rank that can be expected if the student is given the intervention. nr = not reported.

Study Notes: The study used an HLM to combine data from the analysis of schools using both within-school random assignment as well as between-school random assignment. The model as described does not appropriately estimate the difference in outcomes of the intervention and comparison students in the pooled sample. As a result, the WWC considers the analysis of the sample of the schools using within-school random assignment and the sample of schools using between-school random assignment separately. The analysis of the sample of schools using within-school random assignment meets WWC standards without reservations, and the analysis of the sample of schools using between-school random assignment does not meet WWC standards. Consequently, the WWC has used the unadjusted means reported in the study for all WWC calculations of subtest results reported above. A correction for clustering was needed and resulted in WWC-computed *p*-values of 0.11, 0.59, and 0.59 for the properties of arithmetic, rational number equivalence, and solving equations subtests, respectively; therefore, the WWC does not find any of the subtest results to be statistically significant. The result of the main outcome from which these subtests are derived is presented in Appendix C. The WWC calculated the intervention group mean by adding the difference-in-differences adjusted estimate of the average impact of the program (i.e., difference in mean gains between the intervention and comparison groups) to the unadjusted comparison group posttests means. Please see the WWC Procedures and Standards Handbook (version 2.1) for more information.

Endnotes

[1] Single study reviews examine evidence published in a study (supplemented, if necessary, by information obtained directly from the author[s]) to assess whether the study design meets WWC evidence standards. The review reports the WWC's assessment of whether the study meets WWC evidence standards and summarizes the study findings following WWC conventions for reporting evidence on effectiveness. This study was reviewed using the single study review protocol, version 2.0.

Recommended Citation

U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse. (2013, April). *WWC review of the report: The effects of POWERSOURCE© intervention on student understanding of basic mathematical principles*. Retrieved from http://whatworks.ed.gov.

Glossary of Terms

Attrition Attrition occurs when an outcome variable is not available for all participants initially assigned to the intervention and comparison groups. The WWC considers the total attrition rate and the difference in attrition rates across groups within a study.

Clustering adjustment If intervention assignment is made at a cluster level and the analysis is conducted at the student level, the WWC will adjust the statistical significance to account for this mismatch, if necessary.

Confounding factor A confounding factor is a component of a study that is completely aligned with one of the study conditions, making it impossible to separate how much of the observed effect was due to the intervention and how much was due to the factor.

Design The design of a study is the method by which intervention and comparison groups were assigned.

Domain A domain is a group of closely related outcomes.

Effect size The effect size is a measure of the magnitude of an effect. The WWC uses a standardized measure to facilitate comparisons across studies and outcomes.

Eligibility A study is eligible for review if it falls within the scope of the review protocol and uses either an experimental or matched comparison group design.

Equivalence A demonstration that the analysis sample groups are similar on observed characteristics defined in the review area protocol.

Improvement index Along a percentile distribution of students, the improvement index represents the gain or loss of the average student due to the intervention. As the average student starts at the 50th percentile, the measure ranges from –50 to +50.

Multiple comparison adjustment When a study includes multiple outcomes or comparison groups, the WWC will adjust the statistical significance to account for the multiple comparisons, if necessary.

Quasi-experimental design (QED) A quasi-experimental design (QED) is a research design in which subjects are assigned to intervention and comparison groups through a process that is not random.

Randomized controlled trial (RCT) A randomized controlled trial (RCT) is an experiment in which investigators randomly assign eligible participants into intervention and comparison groups.

Single-case design (SCD) A research approach in which an outcome variable is measured repeatedly within and across different conditions that are defined by the presence or absence of an intervention.

Standard deviation The standard deviation of a measure shows how much variation exists across observations in the sample. A low standard deviation indicates that the observations in the sample tend to be very close to the mean; a high standard deviation indicates that the observations in the sample are spread out over a large range of values.

Statistical significance Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups. The WWC labels a finding statistically significant if the likelihood that the difference is due to chance is less than 5% ($p < 0.05$).

Substantively important A substantively important finding is one that has an effect size of 0.25 or greater, regardless of statistical significance.

Please see the WWC Procedures and Standards Handbook (version 2.1) for additional details.