What Works Clearinghouse

INSTITUTE OF EDUCATION SCIENCES

The Expert Mathematician

Program description

The Expert Mathematician is designed to help middle school students develop the thinking processes for mathematical applications and communication. A three-year program of instruction, *The Expert Mathematician* uses a software and consumable print materials package with 196 lessons that teach the *Logo* programming language. Each lesson ranges from 40–120 minutes, or one to three class periods. *The Expert Mathematician* coursework combines integrated computer software with workbook activities. A test of unit concepts is administered at the end of each instructional unit. The developer used the computer program *LogoWriter* to develop the curriculum, which covers general mathematics, pre-algebra, and algebra I. The developer describes the curriculum as covering the range of concepts and content areas in the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards.*

Research

One study on *The Expert Mathematician* met the What Works Clearinghouse (WWC) evidence standards. The one study included 90 eighth-grade students in a middle school in St. Louis, Missouri.[1]

Effectiveness

The Expert Mathematician was found to have a potentially positive effect on math achievement.

	Math achievement
Rating of effectiveness	Potentially positive effects
Improvement index[2]	Average: +14 percentile points Range: +14 percentile points

1. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.
2. These numbers show the average and range of improvement indices in the study. Because there was only one finding reviewed, the average equals the range in this case.

Additional program information

Updating previous research

This report updates the previous WWC report on *The Expert Mathematician* that was released on the WWC website November 2004. This report includes research from the original review. No new studies were identified for this updated report.

Since the original review of *The Expert Mathematician* was first released in November 2004, the WWC has updated its evidence standards and developed peer-review procedures for adjusting such methodological flaws in studies as non-equivalent groups at pretest and a mismatch between the unit of assignment and the unit of analysis. These standards and procedures have been applied to the study included in the original review.

Developer and contact

Developed and distributed by J.J. Baker, Ph.D. Email: frstprin@mniter.net. Web: www.expertmath.org. Telephone: (612) 872-6741.

Scope of use

The Expert Mathematician has been implemented in pilot schools as part of studies of its effects. It became available for adoption by other schools in August 2004.

Teaching

To prepare to teach this curriculum, teachers work through each lesson ahead of their students, following developer-provided instructions. Teachers may introduce or review concepts at the outset of class or alternate direct instruction days with generative learning days. The curriculum encourages teachers to reinforce successes, gently correct mathematical interpretations of activities, and suggest investigations to extend learning. Teachers try to promote critical-thinking skills by prodding students to explain a concept, called the 30-second probe. According to the developer, the curriculum tools do not require extensive training for teachers; instead, the curriculum reduces the teacher's lesson planning time.

Cost

As of September 2006, no cost information was available.

Research

The WWC did not identify any additional studies on *The Expert Mathematician* for the updated review. One study (Baker, 1997) was a randomized controlled trial that met WWC evidence standards under the original review and met WWC evidence standards under the updated review. The study examined the impact of *The Expert Mathematician* on students' mathematics achievement.

Baker (1997) included 90 students who were randomly assigned to either *The Expert Mathematician* (n = 45) or *Transition Math* (n = 45) curriculum. Differences in a math pretest, administered at the start of the school year, favored students in the two *Transition Math* classrooms, who scored 5.3 points higher on average than students in the two *Expert Mathematician* classrooms. The math pretest instrument was administered as a posttest at the end of the school year. Seventy students completed both pre- and posttests. Attrition rates were similar for the intervention and comparison groups. In addition, the pretest was used as a covariate in the posttest analyses, and therefore controlled for post-attrition differences (on the pretest) between the two groups.

Effectiveness

Findings

The WWC review of interventions for middle school mathematics curriculum-based interventions addresses student outcomes in mathematics achievement.

Math achievement. Baker (1997) found *The Expert Mathematician* group did not score statistically significantly higher than the comparison group on the posttest measure of achievement after adjusting for group pretest differences. The WWC confirmed that this finding was not statistically significant but found that it was large enough to be considered substantively important according to WWC criteria.

Effectiveness *(continued)*

Rating of effectiveness

The WWC rates an intervention's effects for 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,[3] the size of the difference between participants in the intervention condition and the comparison condition, and the consistency in findings across studies (see the WWC Intervention Rating Scheme).

The WWC found *The Expert Mathematician* to have potentially positive effects on mathematics 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 favorable results. The improvement index for math achievement is +14 percentile points.

Summary

The WWC reviewed one study on *The Expert Mathematician* that was from the original WWC review. This study met WWC standards and found potentially positive effects in math achievement. The evidence presented in this report is limited and may change as new research emerges.

References

Met WWC evidence standards

Baker, J. J. (1997). Effects of a generative instructional design strategy on learning mathematics and on attitudes towards achievement. *Dissertation Abstracts International, 58*(7), 2573A. (UMI No, 9800955).

For more information about specific studies and WWC calculations, please see the WWC *The Expert Mathematician* Technical Appendices.

3. The level of statistical significance was reported by the study authors or, where 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. See the Technical Details of WWC-Conducted Computations for the formulas the WWC used to calculate the statistical significance. In the case of *The Expert Mathematician,* no corrections were needed.

Appendix

Appendix A1 Study characteristics: Baker, 1997 (randomized controlled trial)

Characteristic	Description
Study citation	Baker, J. J. (1997). Effects of a generative instructional design strategy on learning mathematics and on attitudes towards achievement. *Dissertation Abstracts International, 58*(7), 2573A. (UMI No, 9800955).
Participants	Ninety eighth-grade students. Most students were from low-income families and qualified for free or reduced-price lunches. All but three students were white. None were in special education. Students were randomized to the intervention or the comparison condition. Seventy students completed the math pretest and posttest.
Setting	Suburban middle school in St. Louis, Missouri; four classrooms (two intervention classrooms and two comparison classrooms).
Intervention	The intervention group was taught using a "generative mathematics curriculum" that used *The Expert Mathematician* (version 3.0). Students worked individually or in pairs using the printed materials and the computer to work through the lessons in *The Expert Mathematician.* Sessions, which included one or two lessons, were 85 minutes long and occurred every other day for one school year. Intervention students were taught in separate classrooms from comparison students, but the same teachers taught both groups.
Comparison	The comparison group experienced a "linear mathematics curriculum" based on *Transition Mathematics,* the middle school volume of the University of Chicago School Mathematics Project. The author describes this as a traditional, teacher-directed curriculum. The text covers the first year in a six-year mathematics curriculum.
Primary outcomes and measurement	The 78-item Objectives by Strand test was developed by the district. No norming information was available. The test was administered at the end of the school year by the classroom teacher. (See Appendix A2 for more detailed descriptions of the outcome measure.)
Teacher training	None reported.

Appendix A2 Outcome measure in the math achievement domain

Outcome measure	Description
Objectives by Strand	A 78-item multiple choice test of mathematical ability developed by a large urban school district in 1980 and administered at the end of the school year. Includes 61 concepts and applications items. Average internal consistency (Cronbach's alpha) across the intervention and comparison groups was greater than 0.90. No information on norms was available.

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

Outcome measure	Study sample	Sample size (schools/ students)	Author's findings from the study: Mean outcome (standard deviation[2]) — *Expert Mathematician* group[3]	Author's findings from the study: Mean outcome (standard deviation[2]) — Comparison group	WWC calculations: Mean difference[4] (*Expert Mathematician* – comparison)	WWC calculations: Effect size[5]	WWC calculations: Statistical significance[6] (at $\alpha = 0.05$)	WWC calculations: Improvement index[7]
Baker, 1997 (randomized controlled trial)[8]								
Objectives by Strand test	8th graders	70 students/ 4 classrooms	45.10 (12.03)	40.80 (12.41)	4.30	0.35	ns	+14
Domain average[9] for math achievement						0.35	ns	+14

ns = not statistically significant

1. This appendix reports findings considered for the effectiveness rating and the improvement index.
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. In the case of Baker (1997), a correction for pretest differences was applied to posttest results.
4. Positive differences and effect sizes favor the intervention group; negative differences and effect sizes favor the comparison group.
5. For an explanation of the effect size calculation, please see Technical Details of WWC-Conducted Computations.
6. Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups.
7. 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 favorable results.
8. The level of statistical significance was reported by the study authors 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. See Technical Details of WWC-Conducted Computations for the formulas the WWC used to calculate statistical significance. In the case of Baker (1997), no corrections were needed.
9. This row provides the study average, which in this case is also the domain average. The WWC-computed domain average effect size is a simple average rounded to two decimal places. The domain improvement index is calculated from the average effect size.

Appendix A4 *The Expert Mathematician* 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 *The Expert Mathematician* as having potentially positive effects. It did note meet the criteria for positive effects because it had only one study. The remaining ratings (mixed effects, no discernible effects, potentially negative effects, and negative effects) were not considered because *The Expert Mathematician* was assigned the highest applicable rating.

Rating received

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.

  Met. The one study reviewed by the WWC showed a substantively important positive effect.

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

  Met. The WWC analysis found no studies with statistically significant or substantively important negative effects or with indeterminate 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. There is only one study in this domain, which did not show statistically significant positive effects.

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

  Met. The one study reviewed by the WWC did not show statistically significant negative effects.

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. See the WWC Intervention Rating Scheme for a complete description.