What Works Clearinghouse

Cognitive Tutor® Algebra I

Program Description[2]

The *Cognitive Tutor® Algebra I* curriculum, published by Carnegie Learning, is an approach that combines algebra textbooks with interactive software. The software is developed around an artificial intelligence model that identifies strengths and weaknesses in each individual student's mastery of mathematical concepts. It then customizes prompts to focus on areas where the student is struggling and sends the student to new problems that address those specific concepts.

Research[3]

One study of *Cognitive Tutor® Algebra I* meets What Works Clearinghouse (WWC) evidence standards. The study included 255 ninth-grade students from three junior high schools in Oklahoma.[4]

Based on this study, the WWC considers the extent of evidence for *Cognitive Tutor® Algebra I* to be small for math achievement.

Effectiveness

Cognitive Tutor® Algebra I was found to have potentially positive effects on math achievement.

	Math achievement
Rating of effectiveness	Potentially positive effects
Improvement index[5]	Average: +15 percentile points

1. This report has been updated to include reviews of 11 studies that have been released since 2005. 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 (Shneyderman, 2001) will now be eligible for review as part of the WWC high school math area. (The protocol for the middle school math 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 area.)
2. The descriptive information for this program was obtained from a publicly available source: the program's website (http://www.carnegielearning.com, downloaded September 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 studies in this report were reviewed using WWC Evidence Standards, Version 1.0 (see the WWC Standards).
4. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.
5. This number shows the average student-level improvement index for all findings across the study.

Absence of conflict of interest

The studies Dynarski et. al. (2007) and Campuzano et. al. (2009), cited in the references section below, were prepared, in whole or in part, by staff of Mathematica Policy Research, Inc. (MPR).

However, because the *Cognitive Tutor® Algebra I* study samples fell outside the scope of the review, the studies were not eligible for review under the Middle School Math topic area.

Additional program information

Developer and contact

Cognitive Tutor® Algebra I was developed by and is distributed by Carnegie Learning, Inc. Address: Frick Building, 20th Floor, 437 Grant Street, Pittsburgh, PA 15219. Email: info@carnegielearning.com. Web: http://www.carnegielearning.com/software_features.cfm. Telephone: (888) 851-7094.

Scope of use

Pilot implementation of the curriculum began in 1992 with 84 students in one school. As of August 2008, *Cognitive Tutor®* curricula, which include Bridge to Algebra, Algebra I, Algebra II, Geometry, and Integrated Math, have been used by more than 500,000 students in approximately 2,600 urban, rural, and suburban school districts across the United States. The number of students solely using *Cognitive Tutor® Algebra I* is not available.

Teaching

Cognitive Tutor® Algebra I addresses both mathematical content and process standards. Generally, three periods a week are spent using the *Cognitive Tutor® Algebra I* text for classroom activities, and two periods are spent in the computer lab using the *Cognitive Tutor® Algebra I* software. The textbook aims to foster a collaborative classroom environment where students develop skills to work cooperatively to solve problems, participate in investigations, and propose and compare solutions. Students learn with the adaptive software at their own pace. The math problems are designed to emphasize connections between verbal, numeric, graphic, and algebraic representations.

Cost

Curricula can be purchased as a full license for software and text or as a software-only license. *Cognitive Tutor® Algebra I* as a blended model is available as a set of software and textbooks for a price of approximately $67.70 per student; a teacher text set of materials costs $85. Volume and term discounts are available, as well as site license models for schools purchasing the software only; contact the publisher for a price quote.

Research

Fourteen studies reviewed by the WWC investigated the effects of *Cognitive Tutor® Algebra I*. One study (Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007) is a randomized controlled trial that meets WWC evidence standards. The remaining 13 studies do not meet either WWC evidence standards or eligibility screens.

Meets evidence standards

Ritter, Kulikowich, Lei, McGuire, & Morgan (2007) randomly assigned algebra course sections to the intervention or control curriculum to assess the impact of *Cognitive Tutor® Algebra I* on the math achievement of ninth-grade students in three suburban junior high schools in Oklahoma. During the 2000–01 school year, ten *Cognitive Tutor® Algebra I* classrooms were compared with nine classrooms using McDougal-Littell's Heath Algebra I, a traditional, teacher-directed curriculum. The analysis sample for the end-of-course algebra assessment included ten *Cognitive Tutor® Algebra I* classrooms (153 students) and six traditional classrooms (102 students).[6] Each of six study teachers taught both *Cognitive Tutor® Algebra I* and traditional classrooms.

6. In order to save on the cost of the end-of-course algebra assessment, the study authors randomly selected one control classroom for each teacher to take the exam.

Research *(continued)*

Meets evidence standards with reservations

No studies meet evidence standards with reservations.

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.[7]

The WWC considers the extent of evidence for *Cognitive Tutor® Algebra I* to be small for math achievement.

Effectiveness

Findings

The WWC review of interventions for Middle School Math addresses student outcomes in the math achievement domain. The findings below present the authors' estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *Cognitive Tutor® Algebra I* on students.[8]

Math achievement

Ritter, Kulikowich, Lei, McGuire, & Morgan (2007) reported a positive but not statistically significant effect of *Cognitive Tutor® Algebra I* on the Educational Testing Service (ETS) Algebra End-of-Course Assessment. The effect size was large enough to be considered substantively important according to WWC standards (that is, at least 0.25).

In sum, one study showed a substantively important positive effect in the math achievement domain.

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).

The WWC found *Cognitive Tutor® Algebra I* to have potentially positive effects for 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 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 math achievement is +15 percentile points for the one study.

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 *Cognitive Tutor® Algebra I* is in Appendix A6.
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 WWC Procedures and Standards Handbook, Appendix C for clustering and WWC Procedures and Standards Handbook, Appendix D for multiple comparisons. In the case of Ritter, Kulikowich, Lei, McGuire, & Morgan (2007), no corrections for clustering or multiple comparisons were needed.

The WWC found *Cognitive Tutor® Algebra I* to have potentially positive effects for math achievement *(continued)*

Summary

The WWC reviewed 14 studies on *Cognitive Tutor® Algebra I*. One of these studies meets WWC evidence standards; the remaining 13 studies do not meet either WWC evidence standards or eligibility screens. Based on the one study, the WWC found potentially positive effects on math achievement. The conclusions presented in this report may change as new research emerges.

References

Meets WWC evidence standards

Ritter, S., Kulikowich, J., Lei, P., McGuire, C., & Morgan, P. (2007). What evidence matters? A randomized field trial of *Cognitive Tutor® Algebra I*. In T. Hirashima, H. U. Hoppe, & S. Shwu-Ching Young (Eds.), *Supporting learning flow through integrative technologies* (pp. 13–20). Netherlands: IOS Press.

Additional source:

Morgan, P., & Ritter, S. (2002). *An experimental study of the effects of* Cognitive Tutor® Algebra I *on student knowledge and attitude*. Retrieved November 22, 2006, from http://www.carnegielearning.com/research/research_reports/morgan_ritter_2002.pdf.

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

Aleven, V., McLaren, B., Roll, I., & Koedinger, K. (2006). Toward meta-cognitive tutoring: A model of help seeking with a cognitive tutor. *International Journal of Artificial Intelligence in Education, 16*(2), 101–128. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Arbuckle, W. J. (2005). *Conceptual understanding in a computer-assisted Algebra 1 classroom*. Unpublished doctoral dissertation, University of Oklahoma. The study does not meet WWC evidence standards because it does not provide adequate information to determine whether it uses an outcome that is valid or reliable.

Cabalo, J. V., & Vu, M-T. (2007). *Comparative effectiveness of Carnegie Learning's* Cognitive Tutor® Algebra I *curriculum: A report of a randomized experiment in the Maui school district*. Palo Alto, CA: Empirical Education Inc. The study is ineligible for review because it does not disaggregate findings for the age or grade range specified in the protocol.

Campuzano, L., Dynarski, M., Agodini, R., and Rall, K. (2009). *Effectiveness of reading and mathematics software products: findings from two student cohorts* (NCEE 2009-4041). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Dynarski, M., Agodini, R., Heaviside, S., Novak, T., Carey, N., Campuzano, L., Means, B., Murphy, R., Penuel, W., Javitz, H., Emery, D., & Sussex, W. (2007). *Effectiveness of reading and mathematics software products: Findings from the first student cohort*. Washington, DC: U.S. Department of Education, Institute of Education Sciences. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Koedinger, K. R., & Aleven, V. (2007). Exploring the assistance dilemma in experiments with cognitive tutors. *Educational Psychology Review, 19*(3), 239–264. The study is ineligible for review because it is not a primary analysis of the effectiveness of an intervention.

Plano, G. S., Ramey, M., & Achilles, C. M. (2005). *Implications for student learning using a technology-based algebra program in a ninth-grade algebra course*. Unpublished manuscript. Available from the Mercer Island School District, 4160 86th Ave.

References *(continued)*

SE, Mercer Island, WA 98040. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Additional source:

Plano, G. S. (2004). The effects of the *Cognitive Tutor® Algebra* on student attitudes and achievement in a 9th grade algebra course. *Dissertation Abstracts International, 65*(04), 1291A. (UMI No. 3130130)

Rigeman, S., & McIntire, N. (2005). Enhancing curriculum and instruction through technology. *T.H.E. Journal, 32*(12), 31–34. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Ritter, S., Anderson, J., Koedinger, K., & Corbett, A. (2007). *Cognitive Tutor®*: Applied research in mathematics education. *Psychonomic Bulletin & Review, 14*(2), 249–255. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Rittle-Johnson, B., & Koedinger, K. (2005). Designing knowledge scaffolds to support mathematical problem solving. *Cognition and Instruction, 23*(3), 313–349. The study is ineligible for review because it does not use a comparison group.

Sarkis, H. (2004). Cognitive Tutor® Algebra 1: *Miami-Dade County Public Schools*. Lighthouse Point, FL: The Reliability Group. The study does not meet WWC evidence standards because the intervention and comparison groups are not shown to be equivalent at baseline.

Shneyderman, A. (2001). *Evaluation of the* Cognitive Tutor® Algebra I *program*. Unpublished manuscript. Available from the Miami-Dade County Public Schools Office of Evaluation and Research, 1500 Biscayne Boulevard, Miami, FL 33132. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Wolfson, M., Koedinger, K., Ritter, S., & McGuire, C. (2008). Cognitive Tutor® Algebra I: *Evaluation of Results (1993–1994)*. Pittsburgh, PA: Carnegie Learning, Inc. The study is ineligible for review because it does not use a sample within the age or grade range specified in the protocol.

Additional source:

Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education, 8*(1), 30–43.

Appendix

Appendix A1 Study Characteristics: Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007 (randomized controlled trial)

Characteristic	Description
Study citation	Ritter, S., Kulikowich, J., Lei, P., McGuire, C., & Morgan, P. (2007). What evidence matters? A randomized field trial of *Cognitive Tutor® Algebra I*. In T. Hirashima, H. U. Hoppe, & S. Shwu-Ching Young (Eds.), *Supporting learning flow through integrative technologies* (pp. 13–20). Netherlands: IOS Press. *Additional source:* Morgan, P., & Ritter, S. (2002). *An experimental study of the effects of* Cognitive Tutor® Algebra I *on student knowledge and attitude*. Retrieved November 22, 2006, from http://www.carnegielearning.com/research/research_reports/morgan_ritter_2002.pdf.
Participants	Participants included 426 ninth-grade students (206 treatment, 220 control) who were assigned to one of six algebra teachers in three study schools.[1] Algebra course sections for each teacher were randomly assigned to a curriculum. The study authors eliminated from the analysis 83 students who transferred within the district to a different section of the course, did not enroll in the district for the second semester, did not receive a grade, or whose records indicated a conflict between the curriculum and class assignment.[2] In order to reduce the cost of the Algebra I assessment, only one control class was randomly selected for each teacher involved in the study. The algebra assessment analysis sample included 255 students (153 intervention, 102 control) from 16 classrooms (10 intervention, 6 control). The analysis sample for the grades analyses included 343 students (173 intervention, 170 control) in 19 sections (10 intervention, 9 control); however, grades are a subjective measure and were not included in the effectiveness rating.
Setting	Participating students were from three junior high schools in the Moore Independent School District in Oklahoma. Moore is a suburban school district located near Oklahoma City.
Intervention	Students spent three class periods per week in group activities and classroom discussions using the *Cognitive Tutor® Algebra I* text and two class periods working on problem-solving skills with the *Cognitive Tutor® Algebra I* software. The intervention occurred during the 2000–01 school year, the first year of implementation of *Cognitive Tutor® Algebra I* for the six study teachers.
Comparison	Students in the control group were taught using Heath Algebra I, a traditional textbook published by McDougal–Littell. Study authors do not provide further information on this curriculum. The six study teachers taught both intervention and control classrooms in each of the three schools. At the start of the study, teachers had several years of experience teaching Heath Algebra I.
Primary outcomes and measurement	The study used the Algebra End-of-Course Assessment, developed by the Education Testing Service (ETS). The other two outcomes, which were not taken into account in the effectiveness rating, were first semester grades and second semester (final) grades. For a more detailed description of these outcome measures, see Appendix A2.
Staff/teacher training	All teachers implemented *Cognitive Tutor® Algebra I* for the first time. During the summer prior to the start of the intervention, teachers attended a four-day training course to familiarize themselves with the *Cognitive Tutor®* software and to learn teaching techniques.

1. The study authors excluded from the analysis two schools that did not randomly assign classrooms to a curriculum. One school did not have sufficient computer resources to implement *Cognitive Tutor® Algebra I*. Due to a scheduling error, teachers at the other school taught either *Cognitive Tutor® Algebra I* or the traditional curriculum but not both. Only the three schools that implemented the within-teacher random assignment design were analyzed by the study authors and included in this report.
2. Eleven students whose records indicated a conflict between the curriculum and class assignment were excluded by the study authors due to uncertainty about their classroom experience. The school registrar reported that these students were assigned to the control group that received the traditional curriculum but were actually enrolled in a *Cognitive Tutor® Algebra I* classroom.

Appendix A2 Outcome measures for the math achievement domain

Outcome measure	Description
ETS Algebra End-of-Course Assessment	The ETS Algebra End-of-Course Assessment included 25 multiple-choice and 15 constructed-response items, with each type of question accounting for 50% of the student's score. The questions were designed to assess students' understanding of algebraic concepts, processes, and skills (as cited in Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007).
Math achievement grades	First semester and second semester (final) grades were included as an additional measure of performance. Grades are a subjective measure and were not considered in the effectiveness rating; rather, these outcomes are presented as additional findings in Appendix A4.

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] — *Cognitive Tutor®* group[3]	Authors' findings from the study: Mean outcome (standard deviation)[2] — Comparison group[4]	WWC calculations: Mean difference[5] (*Cognitive Tutor®* – comparison)	WWC calculations: Effect size[6]	WWC calculations: Statistical significance[7] (at $\alpha = 0.05$)	WWC calculations: Improvement index[8]
Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007 (randomized controlled trial)[9]								
ETS Algebra End-of-Course Assessment	Grade 9	16/255	17.41 (5.82)	15.28 (5.33)	2.13	0.38	ns	+15
Domain average for math achievement (Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007)[10]						**0.38**	**ns**	**+15**

ns = not statistically significant

1. This appendix reports findings considered for the effectiveness rating and the average improvement indices for the math achievement domain. Additional findings from the Ritter, Kulikowich, Lei, McGuire, & Morgan (2007) study are not included in these ratings, but are reported in Appendix A4.
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. The *Cognitive Tutor®* value is the unadjusted control group mean plus the program coefficient from the hierarchical linear modeling (HLM) analysis. The standard deviation was obtained from the study authors.
4. The control group mean is unadjusted. The mean and standard deviation were obtained from the study authors.
5. Positive differences and effect sizes favor the intervention group; negative differences and effect sizes favor the comparison group.
6. For an explanation of the effect size calculation, see WWC Procedures and Standards Handbook, Appendix B.
7. Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups.
8. 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 for the intervention group.
9. 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 about the clustering correction, see the WWC Tutorial on Mismatch. 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 Ritter, Kulikowich, Lei, McGuire, & Morgan (2007), no corrections for multiple comparisons or clustering were needed because only one outcome was considered for the effectiveness rating, and the authors accounted for clustering in their HLM analysis.
10. This row provides the study average, which in this instance 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 Summary of additional findings for the math achievement domain[1]

Outcome measure	Study sample	Sample size (classrooms/ students)	Authors' findings from the study: Mean outcome (standard deviation)[2] — *Cognitive Tutor®* group[3]	Authors' findings from the study: Mean outcome (standard deviation)[2] — Comparison group[4]	WWC calculations: Mean difference[5] (*Cognitive Tutor®* – comparison)	WWC calculations: Effect size[6]	WWC calculations: Statistical significance[7] (at $\alpha = 0.05$)	WWC calculations: Improvement index[8]
Ritter, Kulikowich, Lei, McGuire, & Morgan, 2007 (randomized controlled trial)[9]								
First semester grades	Grade 9	19/343	3.22 (1.00)	2.77 (1.16)	0.45	0.42	Statistically significant	+16
Second semester (final) grades	Grade 9	19/343	2.82 (1.12)	2.39 (1.29)	0.43	0.38	Statistically significant	+14

1. This appendix presents additional findings for measures that fall in the math achievement domain. ETS scale scores were used for rating purposes and are presented in Appendix A3. The protocol for the middle school math area states that subjective measures, such as student grades assigned by teachers, do not qualify as relevant outcome measures.
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. The *Cognitive Tutor®* values are the unadjusted control scores group means plus the program coefficients from the hierarchical linear modeling (HLM) analysis. The standard deviations were obtained from the study authors.
4. The control group means are unadjusted. The means and standard deviations were obtained from the study authors.
5. Positive differences and effect sizes favor the intervention group; negative differences and effect sizes favor the comparison group.
6. For an explanation of the effect size calculation, see WWC Procedures and Standards Handbook, Appendix B.
7. Statistical significance is the probability that the difference between groups is a result of chance rather than a real difference between the groups.
8. 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.
9. 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 about the clustering correction, see the WWC Tutorial on Mismatch. 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 Ritter, Kulikowich, Lei, McGuire, & Morgan (2007), a correction for multiple comparisons was needed, so the significance levels may differ from those reported in the original study; no correction for clustering was needed because the authors accounted for clustering in their HLM analysis.

Appendix A5 *Cognitive Tutor® Algebra I* 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 *Cognitive Tutor® Algebra I* as potentially positive. The remaining ratings (mixed, no discernible effects, potentially negative, and negative) were not considered, as *Cognitive Tutor® Algebra I* 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. One study of *Cognitive Tutor® Algebra I* showed a 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.

  Met. No studies of *Cognitive Tutor® Algebra I* showed a statistically significant or substantively important negative effect, and no studies showed 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. No studies of *Cognitive Tutor® Algebra I* showed statistically significant positive effects.

AND

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

  Met. No studies of *Cognitive Tutor® Algebra I* showed statistically significant or substantively important 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. For a complete description, see the WWC Procedures and Standards Handbook, Appendix E.

Appendix A6 Extent of evidence by domain

Outcome domain	Number of studies	Sample size		Extent of evidence[1]
		Schools	Students	
Math achievement	1	3	255	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." For more details on the extent of evidence categorization, see the WWC Procedures and Standards Handbook, Appendix G.