What Works Clearinghouse

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Peer-Assisted Learning Strategies

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Program Description[1]

Peer-Assisted Learning Strategies (PALS) is a peer-tutoring instructional program that supplements the primary reading curriculum.[2] Pairs of students work together on reading activities intended to improve reading accuracy, fluency, and comprehension. Students in the pairs—who alternately take on the roles of tutor and tutee—read aloud, listen to their partner read, and provide feedback during various structured activities. Teachers train students to use the following learning strategies: passage reading with partners, paragraph "shrinking" (or describing the main idea), and prediction relay (predicting what is likely to happen next in the passage). The *Peer-Assisted Learning Strategies* reading program includes separate versions for kindergarten, grade 1, grades 2–6, and high school.

Research[3]

One study of *Peer-Assisted Learning Strategies* that falls within the scope of the Adolescent Literacy review protocol meets What Works Clearinghouse (WWC) evidence standards with reservations. The study included 120 students with an average student age of 9.8 years who attended elementary and middle schools in a southern state.

The WWC review of Adolescent Literacy interventions addresses student outcomes in four domains: alphabetics, reading fluency, comprehension, and general literacy achievement. Based on this one study, the WWC considers the extent of evidence for *Peer-Assisted Learning Strategies* on adolescent learners to be small for the comprehension domain. The one study that meets WWC evidence standards with reservations did not examine the effectiveness of *Peer-Assisted Learning Strategies* on adolescent learners in the alphabetics domain. Outcomes in the reading fluency and general literacy achievement domains did not meet WWC baseline equivalence standards and, therefore, were not included in this report.

Effectiveness

Peer-Assisted Learning Strategies was found to have potentially positive effects on comprehension for adolescent learners.

Table 1. Summary of findings[4]

		Improvement index *(percentile points)*				
Outcome domain	Rating of effectiveness	Average	Range	Number of studies	Number of students	Extent of evidence
Comprehension	Potentially positive effects	+19	na	1	120	Small

na = not applicable

Program Information[5]

Background[6]

Developed by Lynn and Doug Fuchs in 1997,[7] *Peer-Assisted Learning Strategies* is distributed by Vanderbilt Kennedy Center for Research on Human Development. Address: Vanderbilt University, Attn: Flora Murray/PALS Orders, Box 228 Peabody, Nashville, TN 37203-5701. Email: flora.murray@vanderbilt.edu. Web: http://kc.vanderbilt.edu/pals/. Telephone: (615) 343-4782. Fax: (615) 343-1570.

Program details

This report focuses on *Peer-Assisted Learning Strategies* reading programs for grades 2–6 and high school. In each of these versions of the program, students engage in peer-tutoring routines through a series of structured interactions. Teachers assign students to pairs based on an area in which one student is deficient and the other is proficient (initially, the former serves as the tutee and the latter as the tutor). Throughout the intervention, students are assigned different partners and have the opportunity to be both the provider and recipient of tutoring. *Peer-Assisted Learning Strategies* activities last 35 minutes per session and are intended to be implemented three times a week for grades 2–6 and five times every two weeks for high school students. A typical lesson includes the following activities:

1. Partner reading—the "reader" (or tutee) reads aloud, receiving immediate corrective feedback if words are mispronounced. The program calls for the stronger reader in each pair to read first, which is designed to provide an opportunity for the weaker reader in the pair to preview the passage and review difficult words before it is his or her turn to re-read the same text. Students switch roles after five-minute blocks.
2. Paragraph "shrinking"—the reader states the main idea (i.e., who or what the passage is about), gives a 10-word summary of the passage, and provides a sequential retelling of the important events of the passage.
3. Prediction relay—the reader predicts what is likely to happen on the next page, reads aloud from the page, and summarizes the just-read text, with the tutor deciding whether the predictions are accurate. Students switch roles after five-minute blocks.

Student reading materials are not provided as part of either the grades 2–6 or high school versions of *Peer-Assisted Learning Strategies*; teachers select appropriate reading materials, including informational texts about topics such as employment opportunities, life skills, and social relationships. Whereas younger (grades 2–6) students use fictional readings, high school students also read expository text. The motivational system used for the grades 2–6 Peer-Assisted Learning Strategies program involves students earning points for their team by reading sentences without error, working hard, identifying the correct subject and main idea during paragraph summary, and so on. Points are awarded by tutors and teachers and are recorded by students on score cards. Recognition aside, points do not earn material benefits for students in grades 2–6. At the high school level, instead of earning performance points, students earn PALS "dollars" that are redeemed for tangible rewards. Unlike the program version for grades 2–6 students, which is intended to be implemented in the inclusive general education setting, *Peer-Assisted Learning Strategies* for high school students typically has been used by special educators and remedial reading teachers for students with serious reading problems. *Peer-Assisted Learning Strategies* offers teacher training in an all-day workshop at which teachers learn to implement the program through modeling and role playing. Teachers also are provided with a manual describing the program.

Cost

The manual for each grade-level reading version of *Peer-Assisted Learning Strategies* costs from $40 to $44 (rates effective October 2011). It includes teaching scripts and master copies of student materials. Video (or DVD) materials that provide an overview of the grades 2–6 program and optional video materials for high school *Peer-Assisted Learning Strategies* are available for $15 each. For an onsite one-day teacher training workshop, the presenter's fee is estimated at $1,500 plus travel expenses. Additional information can be found on the *Peer-Assisted Learning Strategies* website (http://kc.vanderbilt.edu/pals).

Research Summary

Ninety-seven studies reviewed by the WWC Adolescent Literacy topic area investigated the effects of *Peer-Assisted Learning Strategies.* One study (Fuchs, Fuchs, Mathes, & Simmons, 1997) is a randomized controlled trial with randomization problems that meets WWC evidence standards with reservations. The remaining 96 studies do not meet either WWC evidence standards or eligibility screens. (See references beginning on page 6 for citations of all 97 studies.)

Table 2. Scope of reviewed research

Grade	2–6
Delivery method	Small group
Program type	Supplement
Studies reviewed	97
Meets WWC standards	0 studies
Meets WWC standards with reservations	1 study

Summary of studies meeting WWC evidence standards without reservations

No studies of *Peer-Assisted Learning Strategies* meet WWC evidence standards without reservations.

Summary of studies meeting WWC evidence standards with reservations

Fuchs et al. (1997) examined the effects of *Peer-Assisted Learning Strategies* on 9- and 10-year-old students at 12 elementary and middle schools in a southern state. Initially, 22 schools were stratified into three groups (high level, middle level, and low level) on reading level and socioeconomic status[8] and then randomly assigned to either *Peer-Assisted Learning Strategies* or the control condition within each group. Although random assignment of 22 schools was conducted, only 12 schools were included in the study. These 12 schools were equally divided between the *Peer-Assisted Learning Strategies* and control conditions and among the high-, middle-, and low-level designations. Forty volunteer teachers (20 treatment and 20 control) whose classes included at least one student with a learning disability were selected to participate in the study. After schools were randomly assigned, each teacher indentified three students to participate in the study: a low achiever with a learning disability, a low achiever without a disability, and an average achiever. The resulting study sample included 60 students who received *Peer-Assisted Learning Strategies* and 60 comparison students who received regular reading instruction.[9] The nonrandom selection of students after random assignment was conducted led to the study's rating of meets standards with reservations. The study reported student outcomes after 15 weeks of program implementation.

Effectiveness Summary

The WWC review of Adolescent Literacy interventions addresses student outcomes in four domains: alphabetics, reading fluency, comprehension, and general literacy achievement. The study that influences the findings in this report covers one domain: comprehension. The findings below present the authors' estimates and WWC-calculated estimates of the size and the statistical significance of the effects of *Peer-Assisted Learning Strategies* on adolescent learners.[10]

For a more detailed description of the rating of effectiveness and extent of evidence criteria, see the WWC Rating Criteria later in this report.

Summary of effectiveness for the comprehension domain

One study reported findings in the comprehension domain.

For the full sample of students in the study, Fuchs et al. (1997) found a statistically significant positive effect of *Peer-Assisted Learning Strategies* on the questions correct measure of the Comprehension Reading Assessment Battery (CRAB). According to WWC calculations, the effect was not statistically significant (when adjusted for clustering), but it was large enough to be considered substantively important (i.e., an effect size of at least 0.25).

Thus, for the comprehension domain, one study showed substantively important positive effects. This results in a rating of potentially positive effects, with a small extent of evidence.

Table 3. Rating of effectiveness and extent of evidence for the comprehension domain

Rating of effectiveness	Criteria met
Potentially positive effects *Evidence of a positive effect with no overriding contrary evidence.*	The review of *Peer-Assisted Learning Strategies* had (a) one study showing substantively important positive effects and (b) no studies showing statistically significant or substantively important negative effects.
Extent of evidence	**Criteria met**
Small	The review of *Peer-Assisted Learning Strategies* was based on one study that included 12 schools and 120 students.

References

Study that meets WWC evidence standards with reservations

Fuchs, D., Fuchs, L. S., Mathes, P. G., & Simmons, D. C. (1997). Peer-Assisted Learning Strategies: Making classrooms more responsive to diversity. *American Educational Research Journal, 34*(1), 174–206.

Studies that do not meet WWC evidence standards

Ellis, J. C. (2004). *Intermediate grade reading: Peer-Assisted Learning Strategies applied to a teacher-directed program*. Unpublished master's thesis, Dominican University of California, San Raphael. The study does not meet WWC evidence standards because the measures of effectiveness cannot be attributed solely to the intervention—there was only one unit assigned to one or both conditions.

Fuchs, L. S., Fuchs, D., Kazdan, S., & Allen, S. (1999). Effects of Peer-Assisted Learning Strategies in reading with and without training in elaborated help giving. *Elementary School Journal, 99*(3), 201–219. The study does not meet WWC evidence standards because it uses a randomized controlled trial design that either did not generate groups using a random process or had nonrandom allocations after random assignment, and the subsequent analytic intervention and comparison groups are not shown to be equivalent.

Hudson, K. G. (2004). The effects of Peer-Assisted Learning Strategies on the reading achievement of elementary students with and without decoding weaknesses. *Dissertation Abstracts International, 65(*10A), 77-3754. 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.

Jadhav, D. (2005). *The effect of Peer Assisted Learning Strategies on reading fluency* (Unpublished dissertation). University of Dayton, OH. 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.

Studies that are ineligible for review using the Adolescent Literacy Evidence Review Protocol

Al Otaiba, S. (2001). Children who do not respond to early literacy instruction: A longitudinal study across kindergarten and first grade. *Reading Research Quarterly, 36*(4), 344–349. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Allor, J. H., Fuchs, D., & Mathes, P. G. (2001). Do students with and without lexical retrieval weaknesses respond differently to instruction? *Journal of Learning Disabilities, 34(*3), 264–275. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Apthorp, H., & Clark, T. (2007). *Using strategy instruction to help struggling high schoolers understand what they read* (Issues & Answers Report, REL 2007–No. 038). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Central. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Barley, Z., Lauer, P. A., Arens, S. A., Apthorp, H. S., Englert, K. S., Snow, D., & Akiba, M. (2002). *Helping at-risk students meet standards: A synthesis of evidence-based classroom practices.* Aurora, CO: Mid-Continent Research for Education and Learning. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Barton-Arwood, S. M. (2003). Reading instruction for elementary-age students with emotional and behavioral disorders: Academic and behavioral outcomes. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 64*(3-A), 856. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% general education students.

Additional source:

Barton-Arwood, S. M., Wehby, J. H., & Falk, K. B. (2005). Reading instruction for elementary-age students with emotional and behavioral disorders: Academic and behavioral outcomes. *Exceptional Children, 72*(1) 7–27.

Benner, G. J., Nelson, J. R., Ralston, N. C., & Mooney, P. (2010). A meta-analysis of the effects of reading instruction on the reading skills of students with or at risk of behavioral disorders. *Behavioral Disorders, 35*(2), 86–102. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Calderon, M., Slavin, R., & Sanchez, M. (2011). Effective instruction for English learners. *Future of Children, 21*(1), 103–127. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Calhoon, M. B. (2005). Effects of a peer-mediated phonological skill and reading comprehension program on reading skill acquisition for middle school students with reading disabilities. *Journal of Learning Disabilities, 38*(5), 424–433. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% general education students.

Calhoon, M. B., Al Otaiba, S., Cihak, D., King, A., & Avalos, A. (2007). Effects of a peer-mediated program on reading skill acquisition for two-way bilingual first-grade classrooms. *Learning Disability Quarterly, 30*(3), 169–184. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Calhoon, M. B., Al Otaiba, S., Greenberg, D., King, A., & Avalos, A. (2006). Improving reading skills in predominantly Hispanic Title 1 first-grade classrooms: The promise of Peer-Assisted Learning Strategies. *Learning Disabilities Research & Practice, 21*(4), 261–272. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Cavanaugh, C. L., Kim, A., Wanzek, J., & Vaughn, S. (2004). Kindergarten reading interventions for at-risk students: Twenty years of research. *Learning Disabilities: A Contemporary Journal, 2*(1), 9–21. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Chung, L. L. (2004). A qualitative study of peer-assisted learning for college English as a foreign language learners in Taiwan (China). *Dissertation Abstracts International, 65*(07A), 204-2474. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Dion, E., Brodeur, M., Gosselin, C., Campeau, M., & Fuchs, D. (2010). Implementing research-based instruction to prevent reading problems among low-income students: Is earlier better? *Learning Disabilities Research & Practice, 25*(2), 87–96. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Dion, E., Fuchs, D., & Fuchs, L. S. (2005). Differential effects of Peer-Assisted Learning Strategies on students' social preference and friendship making. *Behavioral Disorders, 30*(4), 421–429. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Dion, E., Morgan, P. L., Fuchs, D., & Fuchs, L. S. (2004). The promise and limitations of reading instruction in the mainstream: The need for a multilevel approach. *Exceptionality, 12*(3), 163–173. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Dunn, B. N. (2009). *PALS: Peer Assisted Learning Strategies* (ED507452). Education Resources Information Center. Online submission. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Eckert, T. L., Codding, R. M., Truckenmiller, A. J., & Rheinheimer, J. L. (2009). Improving children's fluency in reading, mathematics, spelling, and writing: A review of evidence-based academic interventions. In A. Akin-Little, S. G. Little, M. A. Bray, & T. J. Kehle (Eds.), *Behavioral interventions in schools: Evidence-based positive strategies* (pp. 111–124). Washington, DC: American Psychological Association. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Edmonds, M. S., Vaughn, S., Wexler, J., Reutebuch, C., Cable, A., Tackett, K. K., & Schnakenberg, J. W. (2009). A synthesis of reading interventions and effects on reading comprehension outcomes for older struggling readers. *Review of Educational Research, 79*(1), 262–300. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Falk, K. B., & Wehby, J. H. (2001). The effects of Peer-Assisted Learning Strategies on the beginning reading skills of young children with emotional or behavioral disorders. *Behavioral Disorders, 26*(4), 344–359. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Foorman, B. (2008, March). *Reading and language intervention.* PowerPoint® presented at the British Dyslexia Association, Harrogate, UK. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Fuchs, D. (2001). *Upgrading preparatory work to augment reading development: UPWARD for students with disabilities. Final report, September 1, 1997 to August 31, 2001*. Washington, DC: U.S. Dept. of Education, Office of Educational Research and Improvement, Educational Resources Information Center. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Fuchs, D., Berends, M., Yen, L., Fuchs, l., Compton, D., Saenz, L., & McMaster, K. (2006). *What teacher supports are necessary to scale up PALS-reading? A multi-site randomized control trial.* Nashville, TN: Vanderbilt Kennedy Center. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Fuchs, D., Fuchs, L., Yen, L., McMaster, K., Svenson, E., Yang, N., . . . King, S. (2001). Developing first-grade reading fluency through peer mediation. *Teaching Exceptional Children, 34*(2), 90–93. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Fuchs, D., & Fuchs, L. S. (1998). Researchers and teachers working together to adapt instruction for diverse learners. *Learning Disabilities Research & Practice, 13*(3), 126–137. The study is ineligible for review because it does not examine the effectiveness of an intervention.

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Fuchs, D., Fuchs, L. S., & Burish, P. (2000). Peer-Assisted Learning Strategies: An evidence-based practice to promote reading achievement. *Learning Disabilities Research & Practice, 15*(2), 85–91. The study is ineligible for review because it does not examine the effectiveness of an intervention.

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for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

Lemons, C. J., & Fuchs, D. (2010). Modeling response to reading intervention in children with Down syndrome: An examination of predictors of differential growth. *Reading Research Quarterly, 45(*2), 134–168. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% general education students.

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Mallette, B., Maheady, L., & Harper, G. F. (1999). The effects of reciprocal peer coaching on preservice general educators' instruction of students with special learning needs. *Teacher Education and Special Education, 22*(4), 201. The study is ineligible for review because it does not use a comparison group design or a single-case design.

Malmgren, K. W., & Trezek, B. J. (2009). Literacy instruction for secondary students with disabilities. *Focus on Exceptional Children, 41*(6), 1–12. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

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Mathes, P. G., Torgesen, J. K., & Allor, J. H. (2001). The effects of Peer-Assisted Literacy Strategies for first-grade readers with and without additional computer-assisted instruction in phonological awareness. *American Educational Research Journal, 38*(2), 371–410. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample is not within the specified age or grade range.

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Rivera, M. O., Moughamian, A. C., Lesaux, N. K., & Francis, D. J. (2008). *Language and reading interventions for English language learners and English language learners with disabilities.* Portsmouth, NH: RMC Research Corporation, Center on Instruction. The study is ineligible for review because it is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

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Additional source:

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Appendix A: Research details for Fuchs, Fuchs, Mathes, & Simmons (1997)

Fuchs, D., Fuchs, L. S., Mathes, P. G., & Simmons, D. C. (1997). Peer-Assisted Learning Strategies: Making classrooms more responsive to diversity. *American Educational Research Journal, 34*(1), 174–206.

Table A1. Summary of findings

Meets WWC evidence standards with reservations

Outcome domain	Sample size	Study findings: Average improvement index *(percentile points)*	Study findings: Statistically significant
Comprehension	12 schools/120 students	+19	No

Setting

The study took place in 12 elementary and middle schools across three districts of a southern state. Six schools were part of a large urban school system; six were in two suburban districts.

Study sample

Researchers divided 22 elementary and middle schools into high-level, middle-level, and low-level groups and then randomly assigned each school to either *Peer-Assisted Learning Strategies* or the control condition within each group. High-level schools had a relatively high mean reading score and comparatively low proportion of students on free or reduced-price lunch; low-level schools had the reverse profile; and middle-level schools fell between the two on both indices. After random assignment of the 22 schools, 40 teacher volunteers in 12 schools (55% of the schools randomly assigned[11]) were selected to participate in the study. These 12 schools were equally divided between *Peer-Assisted Learning Strategies* and the control condition and among the high-, mid-, and low-level designations (4 schools in each strata). These 40 teachers, 20 in each condition, taught grades 2–6 and were selected according to their reading class composition (classes needed at least one learning disabled student to be eligible). After random assignment was conducted, each teacher identified three students to participate in the study: a low achiever with a learning disability, a low achiever without a learning disability, and an average achiever. Participating students' average age was 9.78 years. In a majority of classes, teachers also identified replacement students in the event that the originally identified students moved away. This review focused on comparisons across student type and included 60 students in the *Peer-Assisted Learning Strategies* group and 60 students in the comparison group.[9]

Intervention group

Twenty teachers implemented *Peer-Assisted Learning Strategies* during regularly scheduled reading instruction, three times per week for 35 minutes each time. The study reported students' outcomes after 15 weeks of program implementation. Students engaged in three reading activities: partner reading with retell, paragraph summary, and prediction relay. During the first activity, each partner read aloud connected text for 5 minutes, for a total of 10 minutes. "Retells" lasted 1 or 2 minutes, depending on grade level. In the first 4 weeks of *Peer-Assisted Learning Strategies*, paragraph summary (also called paragraph "shrinking") was conducted for 20 minutes. During the next 11 weeks, time for paragraph summary was reduced by half to make room for prediction relay. Teachers relied on their basal text for primary reading materials.

Comparison group

Twenty comparison teachers conducted reading instruction in their typical fashion. A majority used the basal reading series prescribed by their school districts. Reading instruction usually meant students reading silently from the basal texts, followed by teacher-led, large-group discussion. Researchers observed little explicit teaching of reading and comprehension in *Peer-Assisted Learning Strategies* and comparison classrooms.

Outcomes and measurement

For both the pretest and the posttest, students took the Comprehensive Reading Assessment Battery (CRAB), which generated three scores: the number of words, questions, and maze choices correct. Only the number of questions correct outcome qualified for this report.[12] For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

Teachers attended a full-day workshop, during which they were shown how to use the program with their students and maintain *Peer-Assisted Learning Strategies* activities during the 15-week treatment. After the workshop, *Peer-Assisted Learning Strategies* project staff attended seven 45-minute lessons being taught by study treatment group teachers to provide help to teachers as necessary. These seven training sessions were not counted as part of the 15-week treatment.

Appendix B: Outcome measures for each domain

Comprehension	
Reading comprehension construct	
Comprehension Reading Assessment Battery (CRAB) Questions Correct score	This assessment makes use of four 400-word traditional folktales approximated to a second- to third-grade readability level. Students first read aloud from one folktale for three minutes and then answer 10 comprehension questions read to them by the examiner, who records their answers. On a second story, students have two minutes to complete a cloze or maze, read aloud for three minutes, and answer 10 comprehension questions. The CRAB generates three scores: the number of words, questions, and maze choices correct. Questions Correct score is the average number (across two 10-question samples) of comprehension questions correct. Questioning is terminated after five consecutive incorrect answers. The number of correct comprehension questions correlated 0.82 with performance on the Reading Comprehension subtest of the Stanford Achievement Test (as cited in Fuchs et al., 1997).

Appendix C: Findings included in the rating for comprehension domain

Outcome measure	Study sample	Sample size	Mean (standard deviation)		WWC calculations			p-value
			Intervention group	Comparison group	Mean difference	Effect size	Improvement index	
Fuchs et al. (1997)[a]								
CRAB: Questions Correct	Average age: 9.8 years	12 schools/ 120 students	6.02 (1.79)	5.18 (1.66)	0.84	0.48	+19	< 0.05
Domain average for comprehension (Fuchs et al., 1997)						**0.48**	**+19**	**Not sig**

Table Notes: Positive results for mean difference, effect size, and improvement index favor the intervention group; negative results favor 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. The statistical significance of the study's domain average was determined by the WWC. CRAB = Comprehension Reading Assessment Battery. Not sig = not statistically significant.

[a] For Fuchs et al. (1997), a correction for clustering of students within schools was needed, and resulted in significance levels that differ from those in the original study. The p-value presented here was reported in the original study. When adjusted for clustering, the WWC-calculated effect on the Questions Correct score of the CRAB was not statistically significant ($p = 0.12$). The *Peer-Assisted Learning Strategies* group mean outcome values presented in Appendix C for Fuchs et al. (1997) differ from those presented in the paper. The WWC calculated the program group mean using a difference-in-differences approach (see WWC Procedures and Standards Handbook, Appendix B), calculating the program means by adding the impact of the program (i.e., difference in mean gains between the intervention and control groups) to the unadjusted control group posttest means.

Endnotes

[1] The descriptive information for this program was obtained from publicly available sources: the program's website (http://kc.vanderbilt.edu/pals, downloaded September 2010) and Fuchs, Fuchs, Kazdan, and Allen (1999); Mathes and Babyak (2001); Mathes, Howard, Allen, and Fuchs (1998); and Mathes et al. (2003). The WWC requests developers to review the program description sections for accuracy from their perspective. The program description was provided to the developer in December 2010. 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 December 2010.

[2] *Peer-Assisted Learning Strategies* also includes separate programs for mathematics.

[3] The studies in this report were reviewed using WWC Evidence Standards, Version 2.1, as described in the Adolescent Literacy review protocol, Version 2.0. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.

[4] For criteria used in the determination of the rating of effectiveness and extent of evidence, see the WWC Rating Criteria later in this report. This improvement index number shows the student-level improvement index for a single finding from one study.

[5] The WWC also reviewed the effects of Peer-Assisted Learning Strategies on the reading achievement of beginning readers, English language learners, and students with learning disabilities. The findings are reported in separate WWC intervention reports.

[6] Patricia Mathes (currently affiliated with Southern Methodist University) is the primary author of a similar program, *Peer-Assisted Literacy Strategies*, for kindergarten and first-grade students, which uses the same peer-learning concepts but also includes a teacher-directed version (in which the teacher always serves as the tutor). Mathes's *Peer-Assisted Literacy Strategies* is distributed by Sopris. Address: 4185 Salazar Way, Frederick, CO 80504. Email: customerservice@cambiumlearning.com. Web: www.soprislearning.com. Telephone: (800) 547-6747. Both of these programs are modeled after Classwide Peer Tutoring. This intervention report focuses on *Peer-Assisted Learning Strategies* because *Peer-Assisted Literacy Strategies* is geared toward early elementary grades that are not covered by this intervention report.

[7] Fuchs, D., Fuchs, L. S., Mathes, P. G., & Simmons, D. C. (1997). Peer-assisted Learning Strategies: Making classrooms more responsive to diversity. *American Educational Research Journal, 34*, 174–206.

[8] High-level schools had a relatively high mean reading score and comparatively low proportion of students on free or reduced-price lunch; low-level schools had the reverse profile; and middle-level schools fell between the two on both indices.

[9] Comparisons within the three subgroups of students (low achievers with a learning disability, low achievers without a disability, and average achievers) are not presented in this report. For two of these three subgroups (low achievers without a disability and average achievers), *Peer-Assisted Learning Strategies* and control students were not equivalent at baseline on reading achievement measures. Subgroup analysis of the third group (low achievers with a learning disability) is beyond the scope of the Adolescent Literacy review.

[10] 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 Fuchs et al. (1997), a correction for clustering was needed, so the significance levels may differ from those reported in the original study.

[11] Overall attrition rate of schools is 45%. Differential attrition cannot be determined, as authors did not respond to the WWC request for information on the division of the initial 22 schools by experimental condition.

[12] Baseline equivalence for the full analysis sample (including all three groups of students) was not demonstrated for the number of words correct and number of maze choices correct outcomes. That is, baseline differences in these outcomes were greater than 0.05 of a standard deviation, and the effects were not statistically adjusted for these differences.

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WWC Rating Criteria

Criteria used to determine the rating of a study

Study rating	Criteria
Meets evidence standards	A study that provides strong evidence for an intervention's effectiveness, such as a well-implemented RCT.
Meets evidence standards with reservations	A study that provides weaker evidence for an intervention's effectiveness, such as a QED or an RCT with high attrition that has established equivalence of the analytic samples.

Criteria used to determine the rating of effectiveness for an intervention

Rating of effectiveness	Criteria
Positive effects	Two or more studies show statistically significant positive effects, at least one of which met WWC evidence standards for a strong design, AND No studies show statistically significant or substantively important negative effects.
Potentially positive effects	At least one study shows a statistically significant or substantively important positive effect, AND No studies show a statistically significant or substantively important negative effect AND fewer or the same number of studies show indeterminate effects than show statistically significant or substantively important positive effects.
Mixed effects	At least one study shows a statistically significant or substantively important positive effect AND at least one study shows 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, OR At least one study shows a statistically significant or substantively important effect AND more studies show an indeterminate effect than show a statistically significant or substantively important effect.
Potentially negative effects	One study shows a statistically significant or substantively important negative effect and no studies show a statistically significant or substantively important positive effect, OR Two or more studies show statistically significant or substantively important negative effects, at least one study shows a statistically significant or substantively important positive effect, and more studies show statistically significant or substantively important negative effects than show statistically significant or substantively important positive effects.
Negative effects	Two or more studies show statistically significant negative effects, at least one of which met WWC evidence standards for a strong design, AND No studies show statistically significant or substantively important positive effects.
No discernible effects	None of the studies shows a statistically significant or substantively important effect, either positive or negative.

Criteria used to determine the extent of evidence for an intervention

Extent of evidence	Criteria
Medium to large	The domain includes more than one study, AND The domain includes more than one school, AND The domain findings are based on a total sample size of at least 350 students, OR, assuming 25 students in a class, a total of at least 14 classrooms across studies.
Small	The domain includes only one study, OR The domain includes only one school, OR The domain findings are based on a total sample size of fewer than 350 students, AND, assuming 25 students in a class, a total of fewer than 14 classrooms across studies.

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 treatment 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 between outcomes and studies.

Eligibility A study is eligible for review and inclusions in this report 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.

Extent of evidence An indication of how much evidence supports the findings. The criteria for the extent of evidence levels are given in the WWC Rating Criteria earlier in this report.

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 treatment 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 treatment and comparison groups.

Rating of effectiveness The WWC rates the effects of an intervention in each domain based on the quality of the research design and the magnitude, statistical significance, and consistency in findings. The criteria for the ratings of effectiveness are given in the WWC Rating Criteria earlier in this report.

Single-case design 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 from the average. A low standard deviation indicates that the data points tend to be very close to the mean; a high standard deviation indicates that the data points 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.