What Works Clearinghouse

ies INSTITUTE OF EDUCATION SCIENCES

Students with Learning Disabilities June 2012

Peer-Assisted Learning Strategies

Report Contents

Program Description[1]

Peer-Assisted Learning Strategies (PALS) is a supplemental peer-tutoring program in which student pairs perform a structured set of activities in reading or math (*PALS Reading* and *PALS Math*, respectively). During the 30-35 minute peer-tutoring sessions, students take turns acting as the tutor, coaching and correcting one another as they work through problems. Pairs work together three or four times per week for reading sessions and two times per week for math sessions. The designation of tutoring pairs and skill assignment is based on teacher judgment of student needs and abilities, and teachers reassign tutoring pairs regularly.

Although *PALS* is for students with diverse academic needs, this intervention report focuses on the use of *PALS* to improve the reading and mathematics skills of students with learning disabilities.

Research[2]

Two studies of *PALS* that fall within the scope of the Students with Learning Disabilities review protocol meet What Works Clearinghouse (WWC) evidence standards without reservations, and one study meets WWC evidence standards with reservations. The three studies included 100 students with disabilities from grades 2–6 in three states, with one of the study samples composed entirely of English language learners with learning disabilities. Based on these three studies, the WWC considers the extent of evidence for *PALS* on students with learning disabilities to be small for the reading fluency, reading comprehension, and mathematics domains. Six other domains are not reported in this intervention report. (See the Effectiveness Summary for further description of all domains.)

Effectiveness

PALS was found to have potentially positive effects on reading fluency and reading comprehension and no discernible effects on mathematics for students with learning disabilities.

Table 1. Summary of findings[3]

Outcome domain	Rating of effectiveness	Improvement index *(percentile points)* Average	Range	Number of studies	Number of students	Extent of evidence
Reading fluency	Potentially positive effects	+14	+7 to +18	2	60	Small
Reading comprehension	Potentially positive effects	+26	+23 to +32	2	60	Small
Mathematics	No discernible effects	+9	+8 to +10	1	40	Small

Program Information

Background

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

Program details

PALS was designed to be used with all students in grades 2–6 as a supplement to the general education curriculum. Recently, *PALS Reading* has been extended to other grade levels, including *K-PALS* (kindergarten), *First Grade PALS*, and *High School PALS*. *PALS Math* also is available. *PALS* has been implemented by hundreds of teachers in Arizona, Iowa, Minnesota, Ohio, Oregon, Tennessee, Texas, and other states. The program has been used with English-proficient students with learning disabilities and English language learners with and without learning disabilities.

PALS is a supplemental peer-tutoring program in which student pairs use a structured set of activities. Teachers first train their students in *PALS* procedures using training lessons from the teacher's manual. Then, student pairs are formed by teachers, and students alternate their roles as tutor and tutee. *PALS* activities vary for reading and math classes.

In *PALS Reading*, the designation of tutoring pairs and the skill assignment to each pair are based on teacher judgment of student needs and abilities. For grades 2–6, *PALS Reading* activities include Partner Reading/Retelling, Paragraph Shrinking, and Prediction Relay. In Partner Reading/Retelling, the stronger reader reads for five minutes, while the weaker reader serves as the coach by identifying errors, initiating correction procedures, and awarding points for each sentence read correctly. After the first student is finished reading, the coach asks the reader what he or she has learned. Students switch roles for the second five minutes and follow the same procedure. During Paragraph Shrinking, students generate main idea statements. The stronger reader reads one paragraph at a time. After reading each paragraph, the reader then determines the main idea. The tutor uses a correction procedure to help the reader correct main idea statements. After five minutes, the students switch roles with the second reader reading new material. During Prediction Relay, the stronger reader has two minutes to predict what he or she might learn or what might happen in each upcoming half-page segment. After reading the segment, the reader has two minutes to evaluate the prediction. After five minutes, the students switch roles and follow the same procedure with new reading material for another five minutes.

In *PALS Math*, the designation of tutoring pairs and the skill assignment to each pair are based on teacher judgment or ongoing curriculum-based measurement data. For the second through sixth grades, *PALS Math* includes two activities in each session. In the first activity, Coaching, the stronger student (the coach) models a series of questions to encourage the weaker student (the player) to internalize a self-talk method for solving computation or concepts/applications problems. As the coach models this series of questions, the player answers questions and writes answers. The coach uses a set of helping and explaining strategies to promote the player's understanding and to correct errors. The materials prompt the students when to switch coach and player roles. The second activity, Practice, is a 5- to 10-minute activity that addresses the skill just practiced during coaching, as well as easier skills at that grade level.

The reading and mathematics activities are modified for kindergarten, first grade, and high school. Grade-appropriate materials and activities are used.

Cost

A one-day *PALS* training workshop costs $1,000 to $1,500 plus travel for the trainer. Teachers' manuals cost $40 each. Other materials available for purchase include a video, a DVD, and assorted grade-appropriate materials, all available for $15 to $44 per unit, depending on grade level and academic area. Additional information can be found on the *Peer-Assisted Learning Strategies* website (http://kc.vanderbilt.edu/pals).

Research Summary

Forty-six studies reviewed by the WWC investigated the effects of *PALS* on students with learning disabilities. Two studies (Fuchs, Fuchs, Phillips, & Hamlett, 1995; Saenz, Fuchs, & Fuchs, 2005) are randomized controlled trials that meet WWC evidence standards without reservations. One study (Fuchs, Fuchs, Mathes, & Simmons, 1997) is a randomized controlled trial that meets WWC evidence standards with reservations. The remaining 43 studies do not meet either WWC eligibility screens or evidence standards. (See references beginning on p. 7 for citations for all 46 studies.)

Table 2. Scope of reviewed research

Grades	2, 3, 4, 5, 6
Delivery method	Small group
Program type	Supplement
Studies reviewed	46
Meets WWC standards without reservations	2 studies
Meets WWC standards with reservations	1 study

Summary of studies meeting WWC evidence standards without reservations

Fuchs et al. (1995) examined the effects of *PALS* on the mathematics achievement of second- to fourth-grade students in nine schools in an urban school district in Tennessee. Teachers who had one or more students with learning disabilities in their math class were recruited to participate in the study. This yielded a sample of 40 teachers who were each asked to identify three students to participate in the study: one low-performing student with a learning disability (identified in accordance with state regulations), one low-performing student who did not have a learning disability, and one average-performing student. Teachers then were randomly assigned to either *PALS* or comparison conditions (20 teachers per group). This WWC review is based on an analysis of a subset of 40 students with learning disabilities (20 *PALS* students and 20 comparison students). Comparison group teachers used their normal approach (business-as-usual). Outcome measures were administered immediately before and after the intervention.

Saenz et al. (2005) examined the effects of *PALS* on the reading fluency and reading comprehension of third- to sixth-grade students in 12 English language learner (ELL) classrooms in one south Texas school district. To participate in the study, a classroom had to have an all-ELL student population with at least two students with a learning disability. The study design was a randomized controlled trial in which 12 classrooms were stratified on grade level and school. Each of the 12 teachers was then asked to identify 11 students to participate in the study: two low-achieving students with a learning disability (identified in accordance with state regulations), three low-achieving students who did not have a learning disability, three average-achieving students, and three high-achieving students. After students were identified, the classrooms were randomly assigned to either *PALS* or comparison conditions (six per group). This WWC review is based on an analysis of a subset of 20 students with learning disabilities (10 *PALS* students and 10 comparison students). Comparison group teachers conducted reading instruction using their normal approach (business-as-usual). Outcome measures were administered before and after the intervention.

Summary of study meeting WWC evidence standards with reservations

Fuchs et al. (1997) examined the effects of *PALS* on reading fluency and reading comprehension of second- to sixth-grade students whose average age was ten. An initial sample of 22 schools from a southern state was stratified on reading scores and the percentage of students who qualified for free or reduced-price meals, and then randomly assigned (within strata) to either *PALS* or comparison conditions. After randomization of schools, teachers who had one or more students with learning disabilities in their reading class were recruited to participate in the study. The recruitment efforts yielded a sample of 40 teachers (20 *PALS* and 20 comparison) from 12 of the 22 schools. Each of the 40 teachers then was asked to identify three students to participate in the study: one low-performing student with a learning disability (identified in accordance with state regulations), one low-performing student who did not have a learning disability, and one average-performing student. This resulted in a total study sample of 120 students. While schools were randomly assigned to *PALS* and comparison groups, this study was

reviewed as a quasi-experimental design because teachers knew their treatment condition when they selected student participants. In addition, teachers were only recruited after random assignment (although teachers were not told their condition during recruitment), and 10 of the schools that were randomized had no eligible teachers. The remaining 12 schools participated throughout the study and included 40 teachers and 40 students with learning disabilities.

The *PALS* and comparison schools in the analysis differed on some measures of school environment (such as the percentage of rural schools). However, based on other measures such as poverty and achievement, the principal investigator concluded that the environments were similar.

This WWC review is based on an analysis from a subset of 40 students with learning disabilities (20 *PALS* students and 20 comparison students). Comparison group teachers conducted reading instruction using their normal approach (business-as-usual). Outcome measures were administered immediately before and after the intervention.

Effectiveness Summary

The WWC review of interventions for students with learning disabilities addresses student outcomes in nine domains: alphabetics, reading fluency, reading comprehension, general reading achievement, mathematics, writing, science, social studies, and progressing in school. The three studies that contribute to the effectiveness rating in this report cover three domains: reading fluency, reading comprehension, and mathematics. The findings below present the authors' estimates and WWC-calculated estimates of the size and statistical significance of the effects of *PALS* on students with learning disabilities. For a more detailed description of the rating of effectiveness and extent of evidence criteria, see the WWC Rating Criteria on p. 21.

Summary of effectiveness for the reading fluency domain

Two studies reported findings in the reading fluency domain.

Fuchs et al. (1997) did not report findings of *PALS*'s impact on the subset of 40 students with learning disabilities. WWC calculations for this sample of students show no statistically significant effects on two measures of reading fluency: the Words Correct and Maze Choices subscales of the Comprehensive Reading Assessment Battery (CRAB). However, the WWC-calculated average effect size across these two measures was 0.31—large enough to be considered substantively important according to WWC criteria (i.e., an effect of at least 0.25). The WWC characterizes these study findings as a substantively important positive effect.

Similarly, Saenz et al. (2005) did not report findings on the subset of 20 students with learning disabilities. WWC calculations for this sample of students show no statistically significant effects on the CRAB Words Correct and Maze Choices subscales. However, the WWC-calculated average effect size across these two measures was 0.41—large enough to be considered substantively important by the WWC. The WWC characterizes these study findings as a substantively important positive effect.

Thus, for the reading fluency domain, the WWC found no statistically significant effects in either study, but WWC-calculated average effect sizes for both studies were large enough to be considered substantively important. This results in a rating of potentially positive effects on reading fluency for students with learning disabilities, with a small extent of evidence.

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

Rating of effectiveness	Criteria met
Potentially positive effects *Evidence of a positive effect with no overriding contrary evidence.*	The review of *PALS* in the reading fluency domain had two studies showing substantively important positive effects, no studies showing a statistically significant or substantively important negative effect, and no studies showing an indeterminate effect.
Extent of evidence	**Criteria met**
Small	The review of *PALS* in the reading fluency domain was based on two studies that included more than 12 schools and 60 students.

Table Note: Extent of evidence is based on data from two studies. One study included 12 schools; the other study included 12 classrooms from an unknown number of schools. Although there were more than 14 classrooms across studies (52 classrooms total), the extent of evidence is small because the classrooms, on average, had fewer than 25 students (none of the classrooms had more than two students).

Summary of effectiveness for the reading comprehension domain

Two studies reported findings in the reading comprehension domain.

Fuchs et al. (1997) did not report findings of *PALS*'s impact on the subset of 40 students with learning disabilities. WWC calculations show no statistically significant effect on one measure of reading comprehension: the Questions Correct subscale of the CRAB. However, the WWC-calculated effect size for this measure was 0.60—large enough to be considered substantively important according to WWC criteria. The WWC characterizes these study findings as a substantively important positive effect.

Similarly, Saenz et al. (2005) did not report findings of *PALS*'s impact on the subset of 20 students with learning disabilities. WWC calculations show no statistically significant effect on the CRAB Questions Correct subscale. However, the WWC-calculated effect size for this measure was 0.91—large enough to be considered substantively important by the WWC. The WWC characterizes these study findings as a substantively important positive effect.

Thus, for the reading comprehension domain, the WWC found no statistically significant effects in either study, but the WWC-calculated average effect sizes for both studies were enough to be considered substantively important. This results in a rating of potentially positive effects, with a small extent of evidence.

Table 4. Rating of effectiveness and extent of evidence for the reading comprehension domain

Rating of effectiveness	Criteria met
Potentially positive effects *Evidence of a positive effect with no overriding contrary evidence.*	The review of *PALS* in the reading comprehension domain had two studies showing substantively important positive effects, no studies showing a statistically significant or substantively important negative effect, and no studies showing an indeterminate effect.
Extent of evidence	**Criteria met**
Small	The review of *PALS* in the reading comprehension domain was based on two studies that included more than 12 schools and 60 students.

Table Note: Extent of evidence is based on data from two studies. One study included 12 schools; the other study included 12 classrooms from an unknown number of schools. Although there were more than 14 classrooms across studies (52 classrooms total), the extent of evidence is small because the classrooms, on average, had fewer than 25 students (none of the classrooms had more than two students).

Summary of effectiveness for the mathematics domain

One study reported findings in the mathematics domain.

Fuchs et al. (1995) did not report findings of *PALS*'s impact on the subset of 40 students with learning disabilities. WWC calculations show no statistically significant effects on two measures of mathematics: the Tennessee Mathematics Operations Test–Revised and the Tennessee Mathematics Concepts and Applications Test. The WWC-calculated average effect size across the two measures was not large enough to be considered substantively important according to WWC criteria. The WWC characterizes these study findings as an indeterminate effect.

Thus, for the mathematics domain, the WWC study did not find statistically significant effects, and the WWC-calculated average effect size was less than 0.25. This results in a rating of no discernible effects, with a small extent of evidence.

Table 5. Rating of effectiveness and extent of evidence for the mathematics domain

Rating of effectiveness	Criteria met
No discernible effects *No affirmative evidence of effects.*	The review of *PALS* in the mathematics domain had no studies showing a statistically significant or substantively important effect, either positive or negative.
Extent of evidence	**Criteria met**
Small	The review of *PALS* in the mathematics domain was based on one study that included nine schools and 40 students.

References

Studies that meet WWC evidence standards without reservations

Fuchs, L. S., Fuchs, D., Phillips, N. B., & Hamlett, C. L. (1995). Acquisition and transfer effects of classwide Peer-Assisted Learning Strategies in mathematics for students with varying learning histories. *School Psychology Review, 24*(4), 604–620.

Saenz, L., Fuchs, L. S., & Fuchs, D. (2005). Peer-Assisted Learning Strategies for English language learners with learning disabilities. *Exceptional Children, 71*(3), 231–247.

Additional source:

Saenz, L. (2002). Peer-Assisted Learning Strategies for limited English proficient students with learning disabilities. *Dissertation Abstracts International, 63*(07A), 163-2505.

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

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 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.

Calhoon, M. B., & Fuchs, L. S. (2003). The effects of Peer-Assisted Learning Strategies and curriculum-based measurement on the mathematics performance of secondary students with disabilities. *Remedial and Special Education, 24*(4), 235. The study does not meet WWC evidence standards because it is a randomized controlled trial in which the combination of overall and differential attrition rates exceeds WWC standards for this area, and the subsequent analytic intervention and comparison groups are not shown to be equivalent.

Fuchs, L. S., Fuchs, D., & Kazdan, S. (1999). Effects of Peer-Assisted Learning Strategies on high school students with serious reading problems. *Remedial and Special Education, 20*(5), 309–318. 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.

Mastropieri, M. A. (2001). Can middle school students with serious reading difficulties help each other and learn anything? *Learning Disabilities Research & Practice, 16*(1), 18. 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.

Studies that are ineligible for review using the Students with Learning Disabilities Evidence Review Protocol

Al Otaiba, S., Schatschneider, C., & Silverman, E. (2005). Tutor-assisted intensive learning strategies in kindergarten: How much is enough? *Exceptionality, 13*(4), 195–208. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Anderson, S., Yilmaz, O., & Wasburn-Moses, L. (2004). Middle and high school students with learning disabilities. *American Secondary Education, 32*(2), 19–38. The study is ineligible for review because it is not a primary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

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.

Baker, S., Gersten, R., Dimino, J. A., & Griffiths, R. (2004). The sustained use of research-based instructional practice. *Remedial and Special Education, 25*(1), 5–24. The study is ineligible for review because it does not include a student outcome.

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.

Bond, R., & Castagnera, E. (2006). Peer supports and inclusive education: An underutilized resource. *Theory Into Practice, 45*(3), 224–229. 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.

Cavanaugh, C. L., Kim, A-H., 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.

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 is a secondary analysis of the effectiveness of an intervention, such as a meta-analysis or research literature review.

Fuchs, D., & Fuchs, L. S. (2005). Peer-Assisted Learning Strategies: Promoting word recognition, fluency, and reading comprehension in young children. *Journal of Special Education, 39*(1), 34–44. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Fuchs, D., & Fuchs, L. S. (2007). Increasing strategic reading comprehension with Peer-Assisted Learning activities. In D. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 175–199). New York: Psychology Press. 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., 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 use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Fuchs, D., Fuchs, L. S., Mathes, P. G., & Martinez, E. A. (2002). Preliminary evidence on the social standing of students with learning disabilities in PALS and no-PALS classrooms. *Learning Disabilities Research & Practice, 17*(4), 205–215. The study is ineligible for review because it does not include an outcome within a domain specified in the protocol.

Fuchs, L. S., & Fuchs, D. (2001). Principles for the prevention and intervention of mathematics difficulties. *Learning Disabilities Research & Practice, 16*(2), 85–95. 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, L. S., Fuchs, D., & Karns, K. (2001). Enhancing kindergartners' mathematical development: Effects of Peer-Assisted Learning Strategies. *The Elementary School Journal, 101*(5), 495–510. The study is ineligible for review because the authors could not confirm that at least 50% of the sample was classified as learning disabled.

Additional source:

Fuchs, L. S., Fuchs, D., Karns, K., Yazdian, L., & Powell, S. (2001). Creating a strong foundation for mathematics learning with kindergarten Peer-Assisted Learning Strategies. *Teaching Exceptional Children, 33*(3), 84.

Gersten, R., Fuchs, L. S., Williams, J. P., & Baker, S. (2001). Teaching reading comprehension strategies to students with learning disabilities: A review of research. *Review of Educational Research, 71*(2), 279. 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.

Ginsburg-Block, M., Rohrbeck, C., Fantuzzo, J., & Lavigne, N. C. (2006). Peer-Assisted Learning Strategies. In G. G. Bear & K. M. Minke (Eds.), *Children's needs III: Development, prevention, and intervention* (pp. 631–645). Washington, DC: National Association of School Psychologists. 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.

Greenwood, C. R., Kamps, D., Terry, B. J., & Linebarger, D. L. (2007). Primary intervention: A means of preventing special education? In D. Haager, J. Klingner, & S. Vaughn (Eds.), *Evidence-based reading practices for response to intervention* (pp. 73–103). Baltimore, MD: Paul H. Brookes. 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.

Greenwood, C. R., Tapia, Y., Abbott, M., & Walton, C. (2003). A building-based case study of evidence-based literacy practices: Implementation, reading behavior, and growth in reading fluency, K–4. *Journal of Special Education, 37*(2), 95. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Harris, A. A. (2009). Comparing effects of two grouping conditions to teach algebraic problem-solving to students with mild disabilities in inclusive settings. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 70(5-A), 1618. The study is ineligible for review because the WWC could not confirm that at least 50% of the sample was classified as learning disabled.

Kunsch, C. A., Jitendra, A. K., & Sood, S. (2007). The effects of peer-mediated instruction in mathematics for students with learning problems: A research synthesis. *Learning Disabilities Research & Practice, 22*(1), 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.

Lorah, K. S. (2003). Effects of peer tutoring on the reading performance and classroom behavior of students with attention deficit hyperactivity disorder. *Dissertation Abstracts International, 64*(04A), 198-1208. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Maccini, P., Mulcahy, C. A., & Wilson, M. G. (2007). A follow-up of mathematics interventions for secondary students with learning disabilities. *Learning Disabilities Research & Practice, 22*(1), 58–74. 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.

Maheady, L., Mallette, B., & Harper, G. F. (2006). Four classwide peer tutoring models: Similarities, differences, and implications for research and practice. *Reading & Writing Quarterly, 22*(1), 65–89. 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.

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.

Mastropieri, M. A., Scruggs, T. E., & Graetz, J. E. (2003). Reading comprehension instruction for secondary students: Challenges for struggling students and teachers. *Learning Disability Quarterly, 26*(2), 103. 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.

Mathes, P. G., Howard, J. K., Allen, S. H., & Fuchs, D. (1998). Peer-Assisted Learning Strategies for first-grade readers: Responding to the needs of diverse learners. *Reading Research Quarterly, 33*(1), 62–94. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

Mathes, P. G., Torgesen, J. K., Clancy-Menchetti, J., Santi, K., Nicholas, K., Robinson, C., & Grek, M. (2003). A comparison of teacher-directed versus peer-assisted instruction to struggling first-grade readers. *Elementary School Journal, 103*(5), 459. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

McMaster, K. L., Fuchs, D., & Fuchs, L. S. (2006). Research on Peer-Assisted Learning Strategies: The promise and limitations of peer-mediated instruction. *Reading & Writing Quarterly, 22*(1), 5–25. 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.

McMaster, K. L., Fuchs, D., & Fuchs, L. S. (2007). Promises and limitations of Peer-Assisted Learning Strategies in reading. *Learning Disabilities: A Contemporary Journal, 5*(2), 97–112. 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.

McMaster, K. L., Fuchs, D., Fuchs, L. S., & Compton, D. L. (2005). Responding to nonresponders: An experimental field trial of identification and intervention methods. *Exceptional Children, 71*(4), 19. The study is ineligible for review because the authors could not confirm that at least 50% of the sample was classified as learning disabled.

Morgan, P. L., Young, C., & Fuchs, D. (2006). Peer-Assisted Learning Strategies: An effective intervention for young readers. *Insights on Learning Disabilities, 3*(1), 23–42. 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.

Mulcahy, C. A., & Krezmien, M. P. (2009). Effects of a contextualized instructional package on the mathematics performance of secondary students with EBD. *Behavioral Disorders, 34*(3), 136–150. The study is ineligible for review because it does not use a sample aligned with the protocol—the sample includes less than 50% students with learning disabilities.

National Center for Learning Disabilities. (1999). *Two decades of research in learning disabilities: Reading comprehension, expressive writing, problem solving, self-concept. Keys to successful learning: A national summit on research in learning disabilities*. New York: Author. 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.

Saddler, B., Asaro, K., & Behforooz, B. (2008). The effects of peer-assisted sentence-combining practice on four young writers with learning disabilities. *Learning Disabilities: A Contemporary Journal, 6*(1), 17–31. The study is ineligible for review because it does not examine an intervention implemented in a way that falls within the scope of the review—the intervention is bundled with other components.

Saenz, L., McMaster, K., Fuchs, D., & Fuchs, L. (2007). Peer-Assisted Learning Strategies in reading for students with different learning needs. *Journal of Cognitive Education and Psychology, 6*(3), 395–410. 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.

Slavin, R. E., Cheung, A., Groff, C., & Lake, C. (2008). *Effective reading programs for middle and high schools: A best evidence synthesis*. Educator's summary. Retrieved from http://www.bestevidence.org/word/mhs_read_Sep_16_2008_sum.pdf. 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.

Slavin, R. E., Cheung, A., Groff, C., & Lake, C. (2008). Effective reading programs for middle and high schools: A best-evidence synthesis. *Reading Research Quarterly, 43*(3), 290–322. 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.

Snow, D. (2003). *Noteworthy perspectives: Classroom strategies for helping at-risk students*. 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.

Vaughn, S., & Gersten, R. (2000). The underlying message in LD intervention research: Findings from research syntheses. *Exceptional Children, 67*(1), 99. 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.

Vaughn, S., Hughes, M. T., Moody, S. W., & Elbaum, B. (2001). Instructional grouping for reading for students with LD: Implications for practice. *Intervention in School and Clinic, 36*(3), 131–137. 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.

Vermette, P., Harper, L., & DiMillo, S. (2004). Cooperative & collaborative learning … with 4–8 year olds: How does research support teachers' practice? *Journal of Instructional Psychology, 31*(2), 130–134. 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.

Wexler, J., Vaughn, S., Edmonds, M., & Reutebuch, C. (2008). A synthesis of fluency interventions for secondary struggling readers. *Reading & Writing, 21*(4), 317–347. 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.

Appendix A.1: Research details for Fuchs et al., (1995)

Fuchs, L. S., Fuchs, D., Phillips, N. B., & Hamlett, C. L. (1995). Acquisition and transfer effects of class-wide Peer-Assisted Learning Strategies in mathematics for students with varying learning histories. *School Psychology Review, 24*(4), 604–620.

Table A1. Summary of findings

Meets WWC evidence standards without reservations

Outcome domain	Sample size	Study findings	
		Average improvement index *(percentile points)*	Statistically significant
Reading comprehension	40 students with learning disabilities	+9	No

Setting

The study was conducted in nine elementary schools in an urban school district in Tennessee.

Study sample

The sample for this study included a total of 120 students in the second, third, and fourth grades: 40 low-performing students with learning disabilities, 40 low-performing students without learning disabilities, and 40 average-performing students. This report reviews findings for only the 40 students with learning disabilities.

The study design was a randomized controlled trial conducted in nine elementary schools. Teachers who had one or more students with learning disabilities in their math class were recruited to participate in the study. The recruitment efforts resulted in a sample of 40 teachers who were randomly assigned to either *PALS* or comparison conditions (20 teachers per group). Each of the 40 teachers was asked to identify three students to participate in the study: one low-performing student with a learning disability (identified in accordance with state regulations), one low-performing student who did not have a learning disability, and one average-performing student. Teachers were not informed of their treatment assignment until after they had selected students to participate in the study. There was no attrition of schools, teachers, or students.

Intervention group

PALS was conducted twice weekly in math classes for 25- to 30-minute sessions for 23 weeks. Students were trained to be *PALS* tutors and tutees in five 30-minute sessions during the week prior to the start of the intervention. Pairs changed every two weeks. Any student who had not been a tutor for the past four weeks was assigned a tutoring role so that within every six-week interval, each student served as a tutor for at least two weeks.

Comparison group

Comparison teachers conducted math classes using their normal approach (business-as-usual).

Outcomes and measurement

The mathematics domain was assessed with two mathematics achievement measures at pretest and posttest. The Tennessee Mathematics Operations Test–Revised samples problems across the first through sixth grades from the Operations portion of the Tennessee state curriculum, whereas the Tennessee Mathematics Concepts and Applications Test samples problems from the Concepts/Applications portions of the curriculum. For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

PALS teachers were trained at a full-day workshop at which they learned both about *PALS* procedures and how to train their students on *PALS*. At the end of the workshop, teachers were given a *PALS* manual that included scripted lessons to be used when conducting student training.

Appendix A.2: Research details for Saenz et al., 2005

Saenz, L. M., Fuchs, L. S., & Fuchs, D. (2005). Peer-Assisted Learning Strategies for English language learners with learning disabilities. *Council for Exceptional Children, 71*(3), 231–247.

Table A2. Summary of findings

Meets WWC evidence standards without reservations

Outcome domain	Sample size	Study findings	
		Average improvement index *(percentile points)*	Statistically significant
Reading fluency	20 ELL students with learning disabilities	+16	No
Reading comprehension	20 ELL students with learning disabilities	+32	No

Setting

This study took place in English-language-learner (ELL) classrooms in one school district in Texas.

Study sample

The sample for this study included 132 native Spanish-speaking students from 12 third- through sixth-grade classrooms in one school district in south Texas. This report reviews findings only for the subset of 20 students with learning disabilities. To be eligible to participate, each of the 12 classrooms had to have an all-ELL student population with at least two students identified as having a learning disability as determined by state and federal criteria.

The study design was a randomized controlled trial in which 12 classrooms were stratified on grade level (grades 3–6) and school (the number of schools was not reported). Each of the 12 teachers was asked to identify 11 students to participate in the study: two low-achieving students with a learning disability (identified in accordance with state regulations), three low-achieving students who did not have a learning disability, three average-achieving students, and three high-achieving students. After students were identified, the classrooms were randomly assigned to either *PALS* or comparison conditions (six per group). Out of the 12 students with learning disabilities assigned to each condition (24 students total), two students were lost from each condition due to relocation, leaving an analysis sample of 10 *PALS* students and 10 comparison students.

Intervention group

PALS was used during regularly scheduled reading instruction for 35 minutes three times a week for 15 weeks. Students were trained to be *PALS* tutors and tutees in five 45-minute sessions during the week prior to the start of the intervention. Teachers created pairs of students (one stronger reader and one weaker reader in each pair), and students alternated their roles as tutor and tutee during each lesson. There were three activities in each lesson, and the reading selection was chosen based on the weaker student's reading level. In the Partner Reading/Retelling activity, the stronger reader read aloud for five minutes, then the weaker reader read the same passage. For each reading, the listener acted as the tutor, correcting errors as they read. In the Paragraph Shrinking activity, the stronger reader read aloud for five minutes, stopping to summarize after every paragraph. The weaker reader then performed the same activity using a new passage. In the Prediction Relay activity, the stronger student read the first half of a passage and then predicted what would happen in the second half. The weaker student then made predictions based on a new passage. Student dyads earned points for their performance.

Comparison group

Comparison teachers conducted reading lessons using their normal approach (business-as-usual).

Outcomes and measurement

The study authors assessed students with the Comprehensive Reading Assessment Battery (CRAB) at the pretest and posttest time points. The reading fluency domain was measured by the Words Correct (number of words read correctly in three minutes across two passages) and the Maze Choices (number of correct maze replacements in two minutes) subscales of the CRAB. The reading comprehension domain was measured by the Questions Correct subscale of the CRAB (average number of questions answered correctly across two 10-question samples). For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

PALS teachers were trained at a full-day workshop at which they learned both about *PALS* procedures and about how to train their students on *PALS*. At the end of the workshop, teachers were given a *PALS* manual that included scripted lessons to be used when conducting student training.

Appendix A.3: Research details for Fuchs et al., 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 A3. Summary of findings — **Meets WWC evidence standards with reservations**

Outcome domain	Sample size	Study findings: Average improvement index *(percentile points)*	Study findings: Statistically significant
Reading fluency	40 students with learning disabilities	+12	No
Reading comprehension	40 students with learning disabilities	+23	No

Setting

The study was conducted in 12 elementary schools from three school districts in a southern state in the United States.

Study sample

The sample for this study included a total of 120 students—40 low-performing students with learning disabilities, 40 low-performing students without learning disabilities, and 40 average-performing students. The students were in grades 2–6, and the average age was 10. This report reviews findings for only the 40 students with learning disabilities.

The study design was a randomized controlled trial in which 22 schools in a southern state in the United States were categorized as high, middle, or low based on mean reading scores and the percentage of students who qualified for free or reduced-price meals. Within each of these three groups, schools were randomly assigned to either *PALS* or comparison conditions. After randomization of schools, teachers who had one or more students with learning disabilities in their reading class were recruited to participate in the study. The recruitment efforts resulted in a sample of 40 teachers (20 *PALS* and 20 comparison) from 12 of the 22 schools. Each of the 40 teachers was then asked to identify three students to participate in the study: one low-performing student with a learning disability (identified in accordance with state regulations), one low-performing student who did not have a learning disability, and one average-performing student.

Study sample *(continued)*

While schools were randomly assigned to groups, this study was reviewed as a quasi-experimental design because teachers knew their treatment condition when they selected student participants. In addition, teachers were only recruited after random assignment (although teachers were not told their condition during recruitment), and 10 of the schools that were randomized had no eligible teachers. The remaining 12 schools participated throughout the study and included 40 teachers and 40 students with learning disabilities. The *PALS* and comparison schools in the analysis differed on some measures (such as the percentage of rural schools); however, the principal investigator concluded that the environments were similar based on important measures such as poverty and achievement.

Intervention group

PALS was conducted during regularly scheduled reading instruction, 35 minutes per day, three times per week, for 15 weeks. Students were trained to be *PALS* tutors and tutees in five 45-minute sessions during the week prior to the start of the intervention.

Comparison group

Comparison teachers conducted reading lessons using their normal approach (business-as-usual).

Outcomes and measurement

The study authors assessed students with the Comprehensive Reading Assessment Battery (CRAB) at the pretest and posttest time points. Reading fluency was measured by the Words Correct (number of words read correctly in three minutes across two passages) and Maze Choices (number of correct maze replacements in two minutes) subscales of the CRAB. Reading comprehension was measured by the Questions Correct subscale of the CRAB (average number of questions answered correctly across two 10-question samples). For a more detailed description of these outcome measures, see Appendix B.

Support for implementation

PALS teachers were trained at a full-day workshop at which they learned both about *PALS* procedures and how to train their students on *PALS*. At the end of the workshop, teachers were given a *PALS* manual that included scripted lessons to be used when conducting student training.

Appendix B: Outcome measures for each domain

Reading fluency	
Comprehensive Reading Assessment Battery (CRAB): Maze Choices subscale	The CRAB is an individually administered measure of reading comprehension that makes use of four 400-word folktales. The student has three minutes to read one of the folktales aloud and to answer 10 questions. The student then has three more minutes to read a second folktale aloud, answer 10 questions, and complete a maze procedure in which every seventh word is replaced with a three-item multiple choice for which only one item is semantically correct. The Maze Choices subscale of the CRAB is scored as the number of correct word replacements (as cited in Fuchs et al., 1997).
CRAB: Words Correct subscale	The Words Correct subscale of the CRAB is scored as the number of words read correctly, averaged across the two 3-minute samples (as cited in Fuchs et al., 1997).
Reading comprehension	
CRAB: Questions Correct subscale	The Questions Correct subscale of the CRAB is scored as the number of questions answered correctly, averaged across the two samples (as cited in Fuchs et al., 1997).
Mathematics	
Tennessee Mathematics Concepts and Applications Test	The Tennessee Mathematics Concepts and Applications Test systematically samples problems across grades 1–6 from the Concepts/Applications portions of the Tennessee state mathematics curriculum (i.e., numeration, concepts, geometry, measurement, charts and graphs, money, word problems). Students are provided directions in standard format and have 15 minutes to complete 50 problems. Performance is scored as number of correct problems. Criterion validity with respect to the applications subtests of the Comprehensive Test of Basic Skills and the Stanford Achievement Test is, respectively, 0.71 and 0.80. Internal consistency reliability as measured by Cronbach's alpha is 0.90 (as cited in Fuchs et al., 1995).
Tennessee Mathematics Operations Test–Revised	The Tennessee Mathematics Operations Test–Revised systematically samples problems across grades 1–6 from the Operations portion of the Tennessee state mathematics curriculum (i.e., addition, subtraction, multiplication, and division of whole numbers, decimals, and fractions). Students are provided directions in standard format and have 10 minutes to complete 50 problems. Performance is scored as the number of correct problems. Criterion validity with respect to the Math Computation subtest of the Stanford Achievement Test is 0.78. Internal consistency reliability as measured by Cronbach's alpha is 0.86 (as cited in Fuchs et al., 1995).

Appendix C.1: Findings included in the rating for the reading fluency 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 Words Correct	Grades 2–6	40 students	253.28 (117.99)	230.88 (116.78)	22.40	0.19	+7	nr
CRAB Maze Choices	Grades 2–6	40 students	11.00 (5.72)	8.60 (5.35)	2.40	0.42	+16	nr
Domain average for reading fluency (Fuchs et al., 1997)						**0.31**	**+12**	**Not statistically significant**
Saenz et al., 2005[b]								
CRAB Words Correct	Grades 3–6	20 students	221.20 (81.17)	188.20 (92.36)	33.00	0.36	+14	nr
CRAB Maze Choices	Grades 3–6	20 students	7.80 (3.16)	6.30 (2.98)	1.50	0.47	+18	nr
Domain average for reading fluency (Saenz et al., 2005)						**0.42**	**+16**	**Not statistically significant**
Domain average for reading fluency across all studies						**0.36**	**+14**	**na**

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 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 WWC-computed average effect size is a simple average rounded to two decimal places; the average improvement index is calculated from the average effect size. The statistical significance of each study's domain average was determined by the WWC; for example, a study is characterized as having a substantively important positive effect if the mean effect is not statistically significant, but the mean effect size reported is positive and substantively important (> 0.25). na = not applicable. nr = not reported. CRAB = Comprehensive Reading Assessment Battery.

[a] Fuchs et al. (1997) conducted a single analysis testing the effectiveness of *PALS* versus a comparison group across three types of students (students with learning disabilities, students who were "average performers," and students who were "low performers"). For the full sample, the authors found that *PALS* students scored significantly higher than comparison students on each of the two outcome measures. The study authors found no significant difference in effects between student types, leading them to conclude that *PALS* was effective for each of the three types of students. However, the study authors did not report the statistical significance of *PALS* versus comparison only for students with learning disabilities. WWC calculations were done on the subset of students with learning disabilities and found no statistically significant difference between *PALS* and comparison students. A correction for multiple comparisons was needed but did not affect significance levels.

[b] Means and standard deviations reported in Saenz et al. (2005) are based on teacher-level aggregations of student data. Because the WWC presents effect sizes calculated using student-level means and standard deviations for comparability across studies, the data presented in this appendix were taken from Saenz (2002), a dissertation on which the Saenz et al. (2005) article is based and in which student-level data were reported. Saenz et al. (1995) conducted a single analysis testing the effectiveness of *PALS* versus a comparison group across four types of students (students with learning disabilities, students who were "high achievers," students who were "average achievers," and students who were "low achievers"). For the full sample, the authors found no significant difference between *PALS* students and comparison students on either of the two outcome measures. The study authors found no significant difference in effects between student types, leading them to conclude that *PALS* was not effective for any of the four types of students. However, the study authors did not report the statistical significance of *PALS* versus comparison only for students with learning disabilities. WWC calculations were done on the subset of students with learning disabilities and found no statistically significant difference between *PALS* and comparison students. A correction for multiple comparisons was needed but did not affect significance levels.

Appendix C.2: Findings included in the rating for the reading 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	Grades 2–6	40 students	5.63 (2.28)	4.15 (2.55)	1.48	0.60	+23	nr
Domain average for reading comprehension (Fuchs et al., 1997)								**Not statistically significant**
Saenz et al., 2005[b]								
CRAB Questions Correct	Grades 3–6	20 students	2.95 (1.43)	1.65 (1.31)	1.30	0.91	+32	nr
Domain average for reading comprehension (Saenz et al., 2005)								**Not statistically significant**
Domain average for reading comprehension across all studies						**0.75**	**+26**	**na**

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 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 WWC-computed average effect size is a simple average rounded to two decimal places; the average improvement index is calculated from the average effect size. The statistical significance of each study's domain average was determined by the WWC; for example: a study is characterized as having a substantively important positive effect if the mean effect is not statistically significant, but the mean effect size reported is positive and substantively important (> 0.25). na = not applicable. nr = not reported. CRAB = Comprehensive Reading Assessment Battery.

[a] Fuchs et al. (1997) conducted a single analysis testing the effectiveness of *PALS* versus a comparison group across three types of students (students with learning disabilities, students who were "average performers," and students who were "low performers"). For the full sample, the authors found that *PALS* students scored significantly higher than comparison students. The study authors found no significant difference in effects between student types, leading them to conclude that *PALS* was effective for each of the three types of students. However, the authors did not report the statistical significance of *PALS* versus comparison only for students with learning disabilities. WWC calculations were done on the subset of students with learning disabilities and showed no statistically significant difference between *PALS* and comparison students.

[b] Means and standard deviations reported in Saenz et al. (2005) are based on teacher-level aggregations of student data. Because the WWC presents effect sizes calculated using student-level means and standard deviations for comparability across studies, the data presented in this appendix were taken from Saenz (2002), a dissertation on which the Saenz et al. (2005) article is based and in which student-level data were reported. Saenz et al. (1995) conducted a single analysis testing the effectiveness of *PALS* versus a comparison group across four types of students (students with learning disabilities, students who were "high achievers," students who were "average achievers," and students who were "low achievers"). For the full sample, the authors found that *PALS* students scored significantly higher than comparison students. The study authors found no significant difference in effects between student types, leading them to conclude that *PALS* was effective for each of the four types of students. However, the authors did not report the statistical significance of *PALS* versus comparison only for students with learning disabilities. WWC calculations were done on the subset of students with learning disabilities and showed no statistically significant difference between *PALS* and comparison students.

Appendix C.3: Findings included in the rating for the mathematics 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., 1995[a]								
Tennessee Math Operations Test	Grades 2–4	40 students	17.10 (6.92)	15.35 (6.27)	1.75	0.26	+10	nr
Tennessee Math Concepts and Applications Test	Grades 2–4	40 students	15.45 (7.10)	14.10 (6.19)	1.35	0.20	+8	nr
Domain average for mathematics (Fuchs et al., 1995)						**0.23**	**+9**	**Not statistically significant**
Domain average for mathematics across all studies						**0.23**	**+9**	**na**

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 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 WWC-computed average effect size is a simple average rounded to two decimal places; the average improvement index is calculated from the average effect size. The statistical significance of the study's domain average was determined by the WWC; for example: a study is characterized as having an indeterminate effect if the mean effect is neither statistically significant nor substantively important (< 0.25). na = not applicable. nr = not reported.

[a] Fuchs et al. (1995) conducted a single analysis testing the effectiveness of *PALS* versus a comparison group across three types of students (students with learning disabilities, students who were "average performers," and students who were "low performers"). For the full sample, the authors found that *PALS* students scored significantly higher than comparison students on each of the two outcome measures. The study authors found no significant difference in effects between student types, leading them to conclude that *PALS* was effective for each of the three types of students. However, the study authors did not report the statistical significance of *PALS* versus comparison only for students with learning disabilities. WWC calculations were done on the subset of students with learning disabilities and found no statistically significant difference between *PALS* and comparison students. A correction for multiple comparisons was needed but did not affect significance levels.

Endnotes

[1] The descriptive information for this program was obtained from publicly available sources: the program's website (http://kc.vanderbilt.edu/pals/, downloaded January 2011) and from Fuchs, Fuchs, Kazdan, and Allen, 1999; Fuchs, Fuchs, Thompson, Al Otaiba, Yen, Yang, . . . O'Conner, 2001; and Mathes and Babyak, 2001. The WWC requests developers to review the program description sections for accuracy from their perspective. The program description was provided to the developer in October 2009, and we incorporated feedback from the developer. Further verification of the accuracy of the descriptive information for this program is beyond the scope of this review. The literature search for this report reflects documents and includes group design studies publicly available by August 2011.

[2] The studies in this report were reviewed using WWC Evidence Standards, version 2.1, as described in the Students with Learning Disabilities review protocol, version 2.1. The evidence presented in this report is based on available research. Findings and conclusions may change as new research becomes available.

[3] For criteria used in the determination of the rating of effectiveness and extent of evidence, see the WWC Rating Criteria on p. 21. These improvement index numbers show the average and range of student-level improvement indices for all findings across the studies.

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WWC Rating Criteria

Criteria used to determine the rating of a study

Study rating	Criteria
Meets WWC evidence standards without reservations	A study that provides strong evidence for an intervention's effectiveness, such as a well-implemented RCT.
Meets WWC 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 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 and inclusion 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 on p. 21.

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.

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 on p. 21.

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 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 tend to be 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.