IES Institute of Education Sciences

Pre-K Mathematics

Intervention Report | *Preparing Young Children for School*

WHAT WORKS CLEARINGHOUSE™
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Pre-K Mathematics is a supplemental mathematics program focusing on a range of mathematical concepts to help develop children's informal mathematical knowledge. The *Pre-K Mathematics* program includes teacher-led, small-group mathematics activities that are engaging and hands-on, as well as caregiver-child activities that are linked to the classroom activities to support children's math learning at home.

Goal: *Pre-K Mathematics* aims to develop preschool children's informal mathematical knowledge, using engaging classroom and home math activities.

The What Works Clearinghouse (WWC) reviews existing research on educational interventions to identify evidence-based programs and practices. This WWC intervention report summarizes the available evidence on the effects of *Pre-K Mathematics* on student outcomes.

Did *Pre-K Mathematics* improve student outcomes?

Five studies of the *Pre-K Mathematics* program meet WWC standards. These studies were conducted in Head Start and state-funded preschool sites. Findings from these studies are summarized in Table 1. The table includes a row for each outcome domain that was studied in the research. An outcome domain includes a group of related outcome measures. The *Pre-K Mathematics* studies primarily included measures that fit within the mathematics domain, but also examined outcomes within the language, reading & literacy related, self-regulation, and social-emotional learning outcome domains. Effects of the program on other outcome domains are unknown.

The WWC effectiveness rating indicates whether the *Pre-K Mathematics* program resulted in improved outcomes for children assigned to receive the program compared with children who were not. The table also indicates whether the evidence reviewed satisfies the Department of Education's requirements for strong, moderate, or promising tiers of evidence at the time this report was written. More information about these ratings and requirements is provided on the next page. Findings and conclusions could change as new research becomes available.

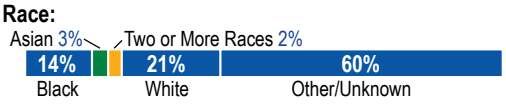
Table 1. Summary of findings on *Pre-K Mathematics* from five studies that meet WWC standards

Outcome domain	Effectiveness rating	Sample size	Evidence tier	Summary of impacts
Mathematics	Positive effects	2,913	TIER 1 STRONG	The research provides strong evidence that *Pre-K Mathematics* improved student mathematics achievement. This assessment is based on five studies that meet WWC standards.
Language	Uncertain effects	296	NO TIER ASSIGNED	The research does not support claims that *Pre-K Mathematics* improved student language. This assessment is based on one study that meets WWC standards.
Reading & Literacy Related	Uncertain effects	966	NO TIER ASSIGNED	The research does not support claims that *Pre-K Mathematics* improved student reading & literacy related achievement. This assessment is based on two studies that meet WWC standards.
Self-Regulation	Uncertain effects	234	NO TIER ASSIGNED	The research does not support claims that *Pre-K Mathematics* improved student self-regulation. This assessment is based on one study that meets WWC standards.
Social-Emotional Learning	Uncertain effects	297	NO TIER ASSIGNED	The research does not support claims that *Pre-K Mathematics* improved student social-emotional learning. This assessment is based on one study that meets WWC standards.

CHARACTERISTICS OF THE STUDY SETTING AND PARTICIPANTS

Settings: Head Start and state-funded preschool sites in the United States.

Race:



Hispanic/Latino: 56%

Female: 52%

Families with incomes below the federal poverty guidelines: 100%

HOW THE WWC REVIEWS AND DESCRIBES EVIDENCE

The WWC conducted a systematic review of interventions designed to improve children's level of preparation for school and selected and prioritized studies for review using the version 4.1 Review Protocol for *Preparing Young Children for School*. The WWC evaluated the quality and results of the selected studies using the criteria outlined in the version 4.1 Procedures and Standards Handbooks and the accompanying Review Protocol for *Preparing Young Children for School*.

The WWC considers each study's research design, whether findings were statistically significant and positive, and the number of studies contributing to this report. The WWC synthesizes evidence across studies—using a weighted average—to determine the effectiveness rating for each outcome domain. The WWC defines outcome domains in the Review Protocol for *Preparing Young Children for School*.

Effectiveness rating	Description of the evidence
Positive (or negative) effects	The evidence base primarily includes the strongest research designs, and the average effect across all high-quality research is statistically significant and positive (or negative).
Potentially positive (or negative) effects	The evidence base primarily includes research with some limitations, and the average effect across all high-quality research is statistically significant and positive (or negative).
Uncertain effects	The average effect across all high-quality research is not statistically significant, so the WWC does not classify it as a positive or a negative effect.

The WWC considers the effectiveness rating, the sample size, and the number of educational sites (states, districts, local education agencies, schools, postsecondary campuses) across studies to determine the evidence tier for each outcome domain. When the effectiveness rating is *uncertain*, *potentially negative*, or *negative effects*, there is no evidence tier.

Evidence tier		Criteria based on evidence synthesis
Strong evidence of effectiveness	TIER 1 STRONG	• Receives an effectiveness rating of positive effects, and • Includes at least 350 students from at least two educational sites
Moderate evidence of effectiveness	TIER 2 MODERATE	• Receives an effectiveness rating of potentially positive effects, and • Includes at least 350 students from at least two educational sites
Promising evidence of effectiveness	TIER 3 PROMISING	• Receives an effectiveness rating of potentially positive effects or positive effects, and • Includes fewer than 350 students or two educational sites

How was *Pre-K Mathematics* implemented?

This section provides details of how Head Start and state-funded preschool sites implemented *Pre-K Mathematics* in the five studies that contribute to this intervention report. This information can help educators identify the requirements for implementing *Pre-K Mathematics* and determine whether implementing this program would be feasible in their districts, schools, or early childhood education centers.

Teachers implementing *Pre-K Mathematics* in their classrooms received training and coaching and a set of materials provided by the developer. Teachers implemented *Pre-K Mathematics* activities in small-group sessions with 4–6 children lasting approximately 15–20 minutes, twice a week for 24–29 weeks. Also, every 1–2 weeks teachers sent home a packet containing a caregiver-child math activity, manipulatives, and a caregiver letter (in English or Spanish) with information about how to do the activity at home. Some teachers also provided children with opportunities to use math software for 5–10 minutes, twice per week during center time.[1]

Comparison group: In the five studies that contribute to this intervention report, children in the comparison group were taught by teachers who did not participate in *Pre-K Mathematics* training and did not implement the *Pre-K Mathematics* sessions. Teachers may have participated in other training offered by their district, school, or early childhood education center.

WWC standards assess the quality of the research, not the quality of the implementation. Studies that meet WWC standards vary in quality of implementation. However, a study must describe the relevant components of the intervention and how each was implemented with adequate detail to be included in an intervention report. Table 2 identifies and describes the components of the program that were implemented in the studies.

Table 2. Implementation of components of *Pre-K Mathematics*

Component	Description of the component	How it was implemented
Classroom math activities	A set of 24 in-class, small-group activities with manipulatives that are intended to develop children's informal mathematical knowledge.	The program offered a new hands-on mathematics activity each week. Each new activity was conducted twice a week for 15–20 minutes in teacher-led small groups consisting of 4–6 children. The activities focused on a range of math concepts, including number sense, arithmetic operations, spatial sense and geometry, pattern knowledge, and measurement and data. Each activity included a core lesson as well as additional activities to tailor the lesson for lower- and higher-performing children. Suggestions for scaffolding to address common child errors or misunderstandings were also provided for each lesson.
Home math activities	A set of 24 caregiver-child math activities linked to the in-class activities that can be used at home to support mathematics learning.	The caregiver letters included a brief explanation of the caregiver-child activity and its purpose, and a picture strip depicting how to conduct the activity at home. The letters were written in English and Spanish. Teachers sent the letters home with manipulatives every 1–2 weeks.
Mathematics software	The software was used to provide children with practice opportunities.	Some teachers loaded mathematics software (e.g., *DLM Early Childhood Express*) on a classroom computer and included it as a center that children could use. Children were encouraged to visit the center for 5–10 minutes twice a week during center time.

Note: The descriptive information for this intervention comes from the intervention website https://prekmath.wested.org/, the five studies that meet WWC standards, and correspondence with the developer. The WWC requests that developers review the intervention description sections for accuracy from their perspective. The WWC provided the developer with the intervention description in January 2023, and the WWC incorporated feedback from the developer.

How much does *Pre-K Mathematics* cost?

This section provides educators with an overview of the resources needed to implement *Pre-K Mathematics*. Table 3 describes the major resources needed for implementation and approximate costs.

Table 3. Resources needed to implement *Pre-K Mathematics*

Resource	Description	Cost
Teacher training	According to the developer, teachers need 4 days of professional development. The training includes instruction in how to implement the curriculum with fidelity, practice conducting the activities, and training in progress monitoring.	The *Pre-K Mathematics* package includes teacher training, curriculum coaching, and materials. Pricing for this package varies by the number of teachers and classrooms. For example, the total cost for 16 teachers from 8 classrooms and 1–2 curriculum coaches is $51,000; the cost for 16 teachers from 16 classrooms and 1–2 curriculum coaches is $61,000; the cost for 24 teachers from 24 classrooms and 1–2 curriculum coaches is $71,500.
Curriculum coaching	According to the developer, teachers need ongoing in-class coaching for the initial year of implementation. The coaching includes observations of the teachers implementing the program and feedback for the teachers. The teacher and coach discuss 1–2 issues per session and possible solutions. Coaches can, for example, be members of a preschool site's professional development staff. They are trained with the teachers during teacher training and receive an additional day of coach-specific training.	
Materials	The developer provides a set of teacher materials (a curriculum binder, a master set of reproducible home activities, and a manipulatives kit) for implementing the program. Each binder includes a generic curriculum plan with classroom activities, embedded math knowledge, and opportunities for review. The binder also includes additional activities for lower- and higher-performing children and recording sheets to monitor children's progress in mastering the activities. Manipulatives in the kit are organized by the math activities included in the curriculum binder.	

For More Information:

About *Pre-K Mathematics*
Email: prekmath@wested.org
Web: https://prekmath.wested.org/

What research did the WWC review about *Pre-K Mathematics*?

This section provides details about the studies of *Pre-K Mathematics* that the WWC examined in its systematic review, including (1) the WWC's ratings of the quality of the available research, (2) the findings from the five studies that meet WWC standards, and (3) the characteristics of the studies that meet WWC standards.

The quality of evidence in the available research about *Pre-K Mathematics*

The WWC identified eight studies that investigated the effectiveness of *Pre-K Mathematics* from a literature search in the Education Resources Information Center (ERIC) and other databases of research studies from January 2005 to January 2022. Of these eight studies, five meet WWC standards and contribute to the summary of evidence in this intervention report. Studies that either do not meet WWC standards or are ineligible for review do not contribute to this intervention report.

- **Four studies meet WWC standards without reservations.** Four studies were cluster randomized controlled trials with low cluster-level attrition and low individual-level nonresponse.
- **One study meets WWC standards with reservations.** This cluster randomized controlled trial provides evidence of effects on individuals by satisfying the baseline equivalence requirement for the individuals in the analytic intervention and comparison groups, but has high individual-level nonresponse.
- **One study does not meet WWC standards.** This cluster randomized controlled trial included a confounding factor so that the measures of effectiveness cannot be attributed solely to the introduction of *Pre-K Mathematics*.
- **Two studies are out of scope of this systematic review.** One randomized controlled trial examined the effectiveness of an intervention that used components of the *Pre-K Mathematics* program but did not use the full intervention. One randomized controlled trial bundled *Pre-K Mathematics* with another intervention, so the effectiveness of Pre-K Mathematics cannot be isolated in this study.

The citations for these eight studies are included in the references. For information on how the WWC determines study ratings, see the *WWC Procedures and Standards Handbooks, Version 4.1*, WWC Standards Briefs, and the Review Protocol for *Preparing Young Children for School*, available on the WWC website.

More details about the five studies of *Pre-K Mathematics* that meet WWC standards

The five studies that meet WWC standards examined the effects of *Pre-K Mathematics* on three measures of mathematics achievement, two measures of language development, three measures of reading & literacy related achievement, five measures of self-regulation skills, and one measure of social-emotional learning. Table 4 lists for each outcome measure, the name of the measure and the study in which the measure was administered, when it was assessed, the sample and setting, the means and standard deviations in the *Pre-K Mathematics* and comparison groups, the effect size, the improvement index, and whether the WWC determined the finding to be statistically significant.

Pre-K Mathematics had positive effects on mathematics achievement because the average effect was statistically significant and positive across all measures in the mathematics domain. The findings from each outcome measure in the mathematics domain were positive and statistically significant. *Pre-K Mathematics* had uncertain effects on outcomes in the language domain, reading & literacy related domain, social-emotional learning domain, and self-regulation domain because the average effect across all outcome measures and studies in each domain was not statistically significant. None of the findings from the outcome measures in these domains were statistically significant.

Table 5 describes characteristics of the five studies of *Pre-K Mathematics* that meet WWC standards, including the study setting and participants.

What is an effect size? The effect size is a standardized measure of the impact of an intervention that can be synthesized across outcome measures and studies. A positive effect size favors the intervention group, and a negative effect size favors the comparison group. Effect sizes further away from 0 mean there was a larger difference between the groups.

What is an improvement index? The improvement index is another measure of the intervention's impact on an outcome. The improvement index can be interpreted as the expected change in percentile rank for an average comparison group child if that child had received the intervention. For example, an improvement index of +5 means that a comparison group child at the 50th percentile would have scored at the 55th percentile if they had received the intervention. The effect size and improvement index measure the same concept in different units, similar to meters and feet for distance. The improvement index is not displayed for outcomes with uncertain effects.

What is statistical significance? A finding is statistically significant if the difference between the intervention and comparison group means was large enough that it is unlikely to have been obtained for an intervention without a true impact. The WWC considers *p* values less than 0.05 to be statistically significant.

Table 4. Findings by outcome domain from five studies of *Pre-K Mathematics* that meet WWC standards

Outcome	Timing of measurement	Sample	Setting	Unadjusted means (standard deviations)		Findings		
				Intervention group	Comparison group	Effect size	Improvement index	Statistically significant (*p* value)
Mathematics outcome domain								
Researcher-Developed: Child Math Assessment (CMA) (DeFlorio et al., 2019)	End of first year of implementation	281 children	27 preschool sites in the United States	0.63 (0.17)	0.51 (0.17)	0.72	+26	Yes ($p < 0.01$)
Researcher-Developed: Child Math Assessment (CMA) (Klein et al., 2008)	End of 29 weeks of implementation	278 children	6 preschool sites in California and New York	0.54 (0.13)	0.47 (0.14)	0.51	+20	Yes ($p < 0.01$)
Test of Early Mathematics Ability, Third Edition (TEMA-3) (Starkey & Klein, 2012)	End of 26 weeks of implementation	669 children	63 preschool sites in California, Indiana, and Kentucky	14.84 (6.95)	12.49 (6.64)	0.35	+14	Yes ($p < 0.01$)
Researcher-Developed: Child Math Assessment (CMA) (Starkey et al., 2022)	End of first year of implementation	371 children	10 preschool sites in California	0.63 (0.16)	0.54 (0.19)	0.51	+19	Yes ($p < 0.01$)
Test of Early Mathematics Ability, Third Edition (TEMA-3) (Starkey et al., 2022)	End of first year of implementation	372 children	10 preschool sites in California	14.24 (6.44)	12.19 (7.06)	0.30	+12	Yes ($p < 0.01$)
Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) Math Assessment (Thomas et al., 2018)	End of first year of implementation	1,313 children	106 preschool sites in California	30.84 (5.48)	29.09 (6.24)	0.30	+12	Yes ($p < 0.01$)
Test of Early Mathematics Ability, Third Edition (TEMA-3) (Thomas et al., 2018)	End of first year of implementation	1,256 children	106 preschool sites in California	16.07 (7.39)	14.33 (7.51)	0.23	+9	Yes ($p < 0.01$)
Summary for Mathematics: positive effects						**0.38**	**+15**	**Yes ($p < 0.01$)**
Language outcome domain								
Peabody Picture Vocabulary Test-III (Klein et al., 2008)	End of 29 weeks of implementation	296 children	6 preschool sites in California and New York	94.99 (12.19)	93.92 (13.89)	0.08	+3	No (p=0.64)
Test of Language Development: Grammatical Understanding Subtest (Klein et al., 2008)	End of 29 weeks of implementation	269 children	6 preschool sites in California and New York	9.51 (2.37)	9.25 (2.29)	0.11	+4	No (p=0.54)
Summary for Language: uncertain effects						**0.10**	**+4**	**No (p=0.57)**

Outcome	Timing of measurement	Sample	Setting	Unadjusted means (standard deviations)		Findings		
				Intervention group	Comparison group	Effect size	Improvement index	Statistically significant (*p* value)
Reading & Literacy Related outcome domain								
Test of Early Reading Ability – 3rd Edition (TERA-3) (Klein et al., 2008)	End of 29 weeks of implementation	270 children	6 preschool sites in California and New York	90.62 (12.64)	89.88 (13.28)	0.06	+2	No (*p*=0.75)
Woodcock-Johnson III Tests of Achievement (WJ-III) Letter-Word Identification Subtest (Klein et al., 2008)	End of 29 weeks of implementation	297 children	6 preschool sites in California and New York	102.54 (13.67)	100.89 (14.34)	0.12	+5	No (*p*=0.51)
Woodcock-Johnson III Tests of Achievement (WJ-III) Spelling Subtest (Klein et al., 2008)	End of 29 weeks of implementation	297 children	6 preschool sites in California and New York	95.39 (12.71)	91.55 (12.12)	0.31	+12	No (*p*=0.08)
Woodcock-Johnson III Tests of Achievement (WJ-III) Letter-Word Identification Subtest (Starkey & Klein, 2012)	End of 26 weeks of implementation	669 children	63 preschool sites in California, Indiana, and Kentucky	340.63 (22.34)	339.52 (22.32)	0.05	+2	No (*p*=0.71)
Summary for Reading & Literacy Related: uncertain effects						**0.09**	**+4**	**No (*p*=0.40)**
Self-Regulation outcome domain								
Day/Night Stroop Task (DeFlorio et al., 2019)	End of first year of implementation	233 children	27 preschool sites in the United States	10.89 (5.69)	10.18 (5.74)	0.13	+5	No (*p*=0.65)
Bear/Dragon Task (DeFlorio et al., 2019)	End of first year of implementation	231 children	27 preschool sites in the United States	8.71 (5.00)	7.70 (5.04)	0.20	+8	No (*p*=0.34)
Gift Delay: Bow Task (DeFlorio et al., 2019)	End of first year of implementation	233 children	27 preschool sites in the United States	37.65 (6.30)	38.40 (3.32)	-0.15	-6	No (*p*=0.56)
Gift Delay: Wrap Task (DeFlorio et al., 2019)	End of first year of implementation	234 children	27 preschool sites in the United States	15.23 (1.15)	15.38 (1.48)	-0.11	-4	No (*p*=0.67)
Yarn Tangle (DeFlorio et al., 2019)	End of first year of implementation	234 children	27 preschool sites in the United States	3.48 (1.82)	3.15 (1.85)	0.18	+7	No (*p*=0.49)
Summary for Self-Regulation: uncertain effects						**0.05**	**+2**	**No (*p*=0.74)**
Social-Emotional Learning outcome domain								
Social Skills Rating System (SSRS): Teacher Report (Klein et al., 2008)	End of 29 weeks of implementation	297 children	6 preschool sites in California and New York	110.81 (13.36)	108.65 (14.95)	0.15	+6	No (*p*=0.39)
Summary for Social-Emotional Learning: uncertain effects						**0.15**	**+6**	**No (*p*=0.39)**

Note: The effect sizes and improvement indices are adjusted for baseline group differences.

Table 5. Characteristics of the five studies of *Pre-K Mathematics* that meet WWC standards

What was the study design?	All five studies used cluster randomized controlled trial designs. Three studies (Klein et al., 2008; Starkey et al., 2022; Thomas et al., 2018) randomly assigned classrooms to implement the *Pre-K Mathematics* intervention or to continue with business as usual, while two studies (DeFlorio et al., 2019; Starkey & Klein, 2012) randomly assigned preschool sites to implement the *Pre-K Mathematics* intervention or to continue with business as usual.
What was the WWC study rating?	Four studies—DeFlorio et al. (2019), Klein et al. (2008), Starkey et al. (2022), and Thomas et al. (2018)—are rated **Meets WWC Group Design Standards Without Reservations** because they are randomized controlled trials with low cluster-level attrition and individual-level nonresponse. One study—Starkey & Klein (2012)—is rated **Meets WWC Group Design Standards With Reservations** because it is a cluster randomized controlled trial that provides evidence of effects on individuals by satisfying the baseline equivalence requirement for the individuals in the analytic intervention and comparison groups, but has high individual-level nonresponse.
Where did the study occur?	**DeFlorio et al. (2019)** • The study took place in 42 classrooms in 27 Head Start and state-funded preschool sites in the United States. **Klein et al. (2008)** • The study took place in 40 classrooms in 6 Head Start and state-funded preschool sites located in California and New York. **Starkey & Klein (2012)** • The study took place in 94 classrooms in 63 Head Start and state-funded preschool sites in California, Indiana, and Kentucky. **Starkey et al. (2022)** • The study took place in 41 classrooms in 10 Head Start and state-funded preschool sites in California. **Thomas et al. (2018)** • The study took place in 140 classrooms in 106 Head Start and state-funded preschool sites in California.
Who participated in the study?	**DeFlorio et al. (2019)** • The intervention group included children in 21 preschool classrooms. The comparison group included children in 21 preschool classrooms. The total number of children in the intervention and comparison groups was 281 children. • Approximately 49% of the children were female. Eighteen percent of the children in the sample were Black, 6% were White, 6% were Asian, and 71% identified as mixed ethnicity or other. Approximately 60% of the children were Hispanic. The mean age of children in the sample was 3.4 years. **Klein et al. (2008)** • The intervention group included children in 20 preschool classrooms. The comparison group included children in 20 preschool classrooms. The total number of children in the intervention and comparison groups was 297 children. • Approximately 48% of the children were female. Fifty-three percent of the children were Black, 22% were White, 4% were Asian, and 4% identified as mixed or other race. Twenty-two percent of the children were Hispanic. The mean age of children in the sample was 4.4 years. **Starkey & Klein (2012)** • The intervention group included children in 48 preschool classrooms. The comparison group included children in 46 preschool classrooms. The total number of children in the intervention and comparison groups was 669 children. • Approximately 54% of the children were female and 9% were English language learners. Fifty-two percent were White, 17% were Black, 3% were Asian, and 9% identified as mixed or other race. Eighteen percent of the children were Hispanic. The mean age of children in the sample was 4.4 years. **Starkey et al. (2022)** • The intervention group included children in 20 preschool classrooms. The comparison group included children in 21 preschool classrooms. The total number of children in the intervention and comparison groups was 372 children. • Approximately 54% of the children were female and 100% were eligible for free or reduced-price lunch. Three percent of the children in the sample were Black, 7% were White, and 14% identified as other race. Approximately 76% of the children were Hispanic. The mean age of children in the sample was 4.5 years. **Thomas et al. (2018)** • The intervention group included children in 70 preschool classrooms. The comparison group included children in 70 preschool classrooms. The total number of children in the intervention and comparison groups was 1,313 children. • Approximately 52% of the children were female. Six percent of the children in the sample were Black, 13% were White, 2% were Asian, and 4% identified as mixed or other race. Approximately 75% of the children were Hispanic. The mean age of children in the sample was 4.4 years.

References

Studies that meet WWC standards without reservations

DeFlorio, L., Klein, A., Starkey, P., Swank, P. R., Taylor, H. B., Halliday, S. E., Beliakoff, A., & Mulcahy, C. (2019). A study of the developing relations between self-regulation and mathematical knowledge in the context of an early math intervention. *Early Childhood Research Quarterly, 46*, 33-48. https://doi.org/10.1016/j.ecresq.2018.06.008

Klein, A., Starkey, P., Clements, D., Sarama, J., & Iyer, R. (2008). Effects of a pre-kindergarten mathematics intervention: A randomized experiment. *Journal of Research on Educational Effectiveness, 1*(3), 155-178. https://eric.ed.gov/?id=EJ873866

Starkey, P., Klein, A., Clarke, B., Baker, S., & Thomas, J. (2022). Effects of early mathematics intervention for low-SES pre-kindergarten and kindergarten students: A replication study. *Educational Research and Evaluation 27*(1-2), 61-82. https://doi.org/10.1080/13803611.2021.2022316

Thomas, J., Cook, T. D., Klein, A., Starkey, P., & DeFlorio, L. (2018). The sequential scale-up of an evidence-based intervention: A case study. *Evaluation Review, 42*(3), 318-357. https://eric.ed.gov/?id=ED587225

Studies that meet WWC standards with reservations

Starkey, P. & Klein, A. (2012). *Scaling up the implementation of a pre-kindergarten mathematics intervention in public preschool programs* [Final Report for IES Grant R305K050004]. U.S. Department of Education. https://eric.ed.gov/?id=ED622610

Studies that do not meet WWC standards

Clements, D. H. & Sarama, J. (2008). Experimental evaluation of the effects of a research-based preschool mathematics curriculum. *American Educational Research Journal, 45*(2), 443-494. https://eric.ed.gov/?id=EJ795943

Studies that are ineligible for review under the study review protocol

Lonigan, C. J., Phillips, B. M., Clancy, J. L., Landry, S. H., Swank, P. R., Assel, M., Taylor, H., Klein, A., Starkey, P., Domitrovich, C. E., Eisenberg, N., Villiers, J., Villiers, P., & Barnes, M. (2015). Impacts of a comprehensive school readiness curriculum for preschool children at risk for educational difficulties. *Child Development, 86*(6), 1773-1793. https://eric.ed.gov/?id=EJ1079878

Sarama, J., Clements, D. H., Starkey, P., Klein, A., & Wakeley, A. (2008). Scaling up the implementation of a pre-kindergarten mathematics curriculum: Teaching for understanding with trajectories and technologies. *Journal of Research on Educational Effectiveness, 1*(2), 89-119. https://eric.ed.gov/?id=EJ873867

Additional sources

The WWC examined additional sources (such as preliminary reports, working papers, or other associated publications) related to the citations in the References to complete its review of these studies. The additional sources are listed on the WWC pages for each study review.

How possible conflicts of interests were addressed when preparing this report

Starkey and Klein led and/or contributed to the development of the *Pre-K Mathematics* program, as well as one of the measures used to assess the program's impacts. They co-authored all the articles that were reviewed and used for evidence for this intervention report. Because Starkey and Klein are the developers of the intervention and one of the measures used in those studies, the research included in this intervention report is not based on independent evaluations of the program.

The intervention report was prepared by Instructional Research Group (IRG), under contract to the Institute of Education Sciences. The WWC team was not involved in developing the program or studying its effectiveness and has no financial interest in the program. All studies that meet WWC standards and the synthesis of their findings were checked and verified through a peer-review process. The Statistics, Website, and Training (SWAT) team conducted an independent review of the evidence to ensure that the WWC's findings are accurate. The Tools, Online Assistance, Standards, and Training (TOAST) team conducted an independent review of the intervention report and the synthesis.

Recommended Citation

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[1] A mathematics software component was used in four of the five studies. *DLM Early Childhood Express* software was present in one of the five studies, and other math software was used in three of the five studies. The impact of this additional component cannot be separated from the impact of the *Pre-K Mathematics* curriculum. However, because mathematics software can be used with *Pre-K Mathematics*, the WWC considers the information in this report to be useful for practitioners in search of a preschool mathematics curriculum.